POLLUTION AND ENVIRONMENT

EDITOR

DR. SANGEETA DAS

ASSISTANT PPROFESSOR,

DEPARTMENT OF BOTANY,

BAHONA COLLEGE, JORHAT, ASSAM, INDIA.

Kripa Drishti Publications, Pune.

POLLUTION

AND

ENVIRONMENT

EDITOR

Dr. Sangeeta Das
Assistant Professor,
Department Of Botany,
Bahona College, Jorhat, Assam, India.

Kripa-Drishti Publications, Pune.

Book Title: **Pollution and Environment**

Editor: **Dr. Sangeeta Das**

Authored by: **Almas Parveen, Dr. Mandira Gupta, Naira Nayab, Dr. Md Anzer Alam, Subhashini A., Dr. Utpal Goswami, Dr. Rajabhuvaneswari Ariyamuthu, Bhuyan Pinky Moni, Nath Pranab Kumar, Devid Kardong, Gogoi Dip Kumar, Lopamudra Ghosh, Komal Rajoriya, Ramhari Meena, Anita Kumari, Tanmay Ghosh, Dr. B. Mallesh Reddy, Dr. Arpan Manna, Dr. Shaveta Chauhan, डॉ. राजेश मौर्य, प्रो. जे. पी. मित्तल**

1st Edition

ISBN: **978-93-90847-02-0**

Published: **Dec 2021**

Publisher:

KRIPA DRISHTI PUBLICATIONS

Kripa-Drishti Publications

A/ 503, Poorva Height, SNO 148/1A/1/1A,
Sus Road, Pashan- 411021, Pune, Maharashtra, India.
Mob: +91-8007068686
Email: editor@kdpublications.in
Web: https://www.kdpublications.in

CONTENT

ISBN: 978-93-90847-02-0

1. Climate Change and Environment

Almas Parveen

Research Scholar,
Department of Education,
Al-Falah University,
Daujh Faridabad, Haryana.

Dr. Mandira Gupta

Principal,
Institute of vocational Studies (GGSIP University),
New Delhi.

Abstract:

Climate change refers to the change in the environmental conditions of the earth. This happens due to many internal and external factors. The climatic change has become global concern over the last few decades. Besides, these climatic changes affect life on the earth in various ways. Global climate change is one of the major issues of the world today. Anticipating the future under the influence of climate change is one of the most important challenges of this time. The main focus of this paper is to provide an update and a detail report on the wide range of impacts of climate change based on the IPCC report and also suggests some solutions to reduce emissions so that we can protect our environment.

Keywords: *Climate, Environment, Emissions, Adaptations.*

1.1 Introduction:

Climate change refers to long turn shift in temperature and weather patterns. These shifts may be natural, such as through variations in the solar cycle. But since the 1800s, human activities have been the main driver of climate change, primarily due to burning fossil fuels like coal, oil and gas. Burning fossil fuels generates greenhouse gas emissions that act like a blanket wrapped around the earth, trapping the sun's heat, and raising temperature examples of greenhouse gas emissions that are causing climate change include carbon dioxide and methane. These come from using gasoline for driving a car or coal for heating a building, for example clearing land and forest can also release carbon dioxide. Landfills for garbage are a major source of methane emissions energy, industry, transport, buildings, agriculture and land use are among the main emitters and emissions continue to rise. As a result, the earth is now about 1.1°c Warmer than it was in the last 1800s. The last decade (2011-2020) was the warmest on record. Many people think climate change mainly means temperatures. But temperature rise is only the beginning of the story. Because the earth is a system, where everything is connected, changes in one area can influence changes in all others. The consequence of climate change now includes, among others, intense drought, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms, and declining biodiversity.

Climate change can affect our health, ability to grow food, housing safety and work. Some of us are already more vulnerable to climate impacts, such as people living in small island nations and other developing countries. Conditions like sea level rise and saltwater intrusion have advanced to the point where whole communities have had to relocate and protracted drought are putting people at risk of famine in the future, the number of climate refuges is expected to rise.

In 2018 UN report, thousands of scientist and government reviewers agreed that limiting global temperature rise to no more than 1.5°c would help us avoid the worst climate impact and maintain a liveable climate. Yet the current path of carbon dioxide emissions could increase global temperatures by as much as 4.4°c by the end of the century. The emissions that cause climate change come from every part of the world and affect everyone, but some countries produce much more than others. The 100 least emitting countries generate 3% of total emissions. The 10 countries with the largest emissions contribute 68%. Everyone must take climate action, but people and countries creating more of the problem have a greater responsibility to act first.

Climate change is considered one of the most serious threats to sustainable development, with adverse impacts on the environment, human health, food security, economic activity, natural resources, and physical infrastructure. Global climate varies naturally. According to the inter-governmental panel on climate change (IPCC), the effects of climate change have already been observed, and scientific finding indicate that precautionary and prompt action is necessary. Vulnerability to climate change is not just a function of geography or dependence on natural resources, it also has social, economic, and political dimensions which influence how climate change affects different groups.

Scientists are observing changes in the earth's climate in every region and across the whole climate system, according to the latest intergovernmental panel on climate change report.

Many of the changes observed in the climate are unprecedented in thousands, if not hundreds of thousands of years, and some of the changes already set in motion such as continued sea level rise are irreversible our hundreds to thousands of years.

However, strong, and sustained reductions in emissions of carbon dioxide and other greenhouse gases would limit climate change. While benefits for air quality would come quickly, it could take 20-30 years to use global temperatures stabilize, according to the IPCC working group I report, climate change 2021: the physical science basis, approved on Friday by 195-member government of the IPCC, through a virtual approval session that was held our two weeks starting on July 26.

1.2 Faster Warming:

The report provides new estimates of the chances of crossing the global warming level of 1.5°c in the next decades, and finds that unless there are immediate, rapid, and large-scale reductions in greenhouse gas emissions, limiting warming to close to 1.5°c or even 2°c will be beyond reach.

The report shows that emissions of greenhouse gases from human activities are responsible for approximately 1.1°c of warming since 1850-1900, and that averaged over the next 20 years global temperature is expected to reach or exceed 1.5°c of warming. Their assessment is based on improved observational data sets to assess historical warming, as well progress in scientific understanding of the response of the climate system to human caused greenhouse gas emissions.

1.3 Every Region Facing Increasing Changes:

Many characteristics of climate change directly depend on the level of global warming. But what people experience is often very different to the global average in the coming decade's climate changes will increase in all regions. For 1.5°c global warming, there will be increasing heat waves, longer warm seasons, and shorter cold seasons. At 2°c of global warming, heat extremes would more often reach critical to clearance thresholds for agriculture and health the report shows.

But it is not just about temperature. Climate change is bringing multiple different changes in different regions which will all increase with further warming. These include changes to wetness and dryness, to winds, snow and ice, coastal areas, and oceans.

a. A climate change is increasing the water cycle. This brings heavy rainfall and associated flooding, as well as more intense drought in many regions.
b. Climate change is affecting rainfall patterns. Its high latitudes, precipitation is likely to increase, while it is protected to decease our large parts of the subtropics. Changes to monsoon precipitation are expected, which will vary by region.
c. Coastal areas will see continued sea level rise throughout the 21st century, contributing to more frequent and severe coastal flooding in low lying areas and coastal erosion. Extreme sea level events that previously occurred once in 100 years could happen every year by the end of this century.
d. Further warming will amplify permafrost thawing, and the loss of seasonal snow cover, melting of glaciers and ice sheets, and loss of summer arctic sea ice.
e. Changes to the ocean, including warming more frequent marine hea t waves ocean acidification, and reduced oxygen levels have been clearly linked to human influence. These changes affect both ocean ecosystems and the people that rely on them, and they will continue throughout at least the rest of this century.
f. For cities, some aspects of climate change may be amplified, including heat, flooding from heavy precipitation events and sea level rise in coastal cities.

1.4 Human Influence on the Past and Future Climate:

It has been clear for decades that the earth's climate is changing and the role of human influence on the climate systems is undisputed, said Mason human actions still have the potential to determine the future Course of climate.

The evidence is clear that carbon dioxide is the main driver of climate change, even as other greenhouse gases and air pollutants also affect the climate.

"Stabilizing the climate will require strong rapid, and sustained reductions in greenhouse gas emissions, and reaching net zero carbon dioxide emissions. Limiting other greenhouse gases and air pollutants, especially methane, could have benefits both for health and the climate".

1.5 Solutions:

Many climate change solutions can deliver economic benefits while impressing our lives and protecting the environment we also have global agreements to guide progress, such as the UN framework convention on climate change and the Paris Agreement. The broad categories of action are cutting emissions, adapting to climate impacts, and financing required adjustments. Switching energy system from fossil fuels to renewable s like solar or wind will reduce the emissions driving climate change. But we have to start right now. While a growing coalition of countries is committing to net zero emissions by 2050, about half of emissions cuts must be in place by 2030 to keep warming below 1.5°c. Fossil fuels production must decline by roughly 6% per year between 2020 and 2030.

Adapting to climate consequences protects people, homes, business, livelihoods, infrastructure, and natural ecosystems. It covers current impacts and those likely in the future.

Adaptation will be required everywhere but must be prioritized now for the most vulnerable people with the fewest resources to cope with climate hazards. The rate of return can be high. Early warning systems for disasters, for instance, same lives and property and can deliver benefits up to 10 times the initial lost.

Climate action requires significant financial investments by governments and business. But climate inaction is vastly more expensive. One critical step is for industrialized counties to fulfil their commitment to provide $100 billion a year to developing countries so they can adapt and move towards greater economics.

Other strategies include early warning systems for extreme events, better management, and improved risk management, various insurance options and biodiversity conservation. Because of the speed at which climate change is happening due to global temperature rise, it is urgent that the vulnerability of developing countries to climate change is reduced and their capacity to adapt is increased and national adaptation plans are implemented. Adapting to climate change will entail adjustments and charges at every level from community to national and international. Community must build their resilience, including adopting appropriate technologies while making the most of traditional knowledge, and diversifying their livelihoods to cope with current and future climate stress. Local coping strategies and knowledge need to be used in systems with government and local interventions. The need of adaptation interventions depends on national circumstances. There is a large body of knowledge and experience within local communities have always aimed to adapt to variations in their climate to do so they have made preparation based on their resource and their knowledge accumulated though experience of past weather patterns. This includes times when they have also been course rear to and recover from extreme events, such as floods, drought, and hurricanes.

Local copy strategies are an important element of planning for adaptation. Climate changes reading communities to experience climatic extreme more frequently, as well as new climate conditions and extreme. Traditional knowledge can help to provide efficient, appropriate and time – tested ways of advising and enabling adaptation to climate change in communities who are feeling the effect of climate change due to global warming.

1.6 Conclusions:

Human- induced climate change has contributed to changing patterns of extreme across the globe from longer and hotter heat waves to heavier rains. Extreme weather is on the rise, and the indications are that it will continue to increase in both predictable and unpredictable ways. Rise in average temperature, a decrease monsoon precipitation, a rise in extreme temperature and rainfall events, drought, and sea levels, and an increase in the intensity of severe cyclones, alongside other changes in the monsoon system. There is compelling scientific evidence that anthropogenic activities have more influenced their changes in regional climate. To improve the accuracy of further climate projections particularly in the context, it is essential to develop strategic approaches for improving the knowledge of earth system process, and to continue enhancing observation systems and climate models.

1.7 References:

1. https://reliefweb.int/report/india/assessment-climate-change-over-indian-region-report-ministry-earth-sciences-moes
2. https://en.wikipedia.org/wiki/Climate_change_in_India
3. https://www.un.org/en/climatechange/what-is-climate-change
4. Kreft, Sönke; David Eckstein, David; Melchior, Inga (November 2016). Global Climate Risk Index 2017 (PDF). Bonn: Germanwatch e.V. ISBN 978-3-943704-49-5. Archived from the original (PDF) on 25 September 2017. Retrieved 10 July 2017.
5. USAID (September 2018). "Greenhouse Gas Emissions in India" (PDF). Retrieved 10 June 2021.
6. UN Environment Programme (2019). "Emissions Gap Report 2019". UNEP - UN Environment Programme. Retrieved 10 June 2021.
7. "How climate change hits India's poor". BBC News. 1 Feb 2007. Retrieved 10 June 2021.
8. "Warmer Tibet can see Brahmaputra flood Assam | India News - Times of India". The Times of India. Retrieved 2021-03-11.
9. "The Carbon Brief Profile: India". Carbon Brief. 2019-03-14. Retrieved 2019-09-25.
10. Government of India (2018) India Second Biennial Update Report to the United Nations Framework Convention on Climate Change
11. "India: Third Biennial Update Report to The United Nations Framework Convention on Climate Change" (PDF).
12. "By 2030, Cut Per Capita Emission to Global Average: India to G20". The Leading Solar Magazine in India. Retrieved 2021-09-17.
13. "A comprehensive GHG inventory for India is within reach". www.downtoearth.org.in. Retrieved 2019-09-25.
14. "Greenhouse Gas Emissions Factsheet: India". Climatelinks. Retrieved 2020-04-23.

15. Hossain, M. (2011), "Climate Change Impacts and Adaptation Strategies for Bangladesh", Climate Change and Growth in Asia, Edward Elgar Publishing (published 11 May 2011),
16. "How climate change hits India's poor". 2007-02-01. Retrieved 2021-03-11.
17. Feb 3, Nitin Sethi / TNN /; 2007; Ist, 01:54. "Global warming: Mumbai to face the heat | India News - Times of India". The Times of India. Retrieved 2021-03-11.
18. Normile, D. (2000-05-12). "GLOBAL WARMING: Some Coral Bouncing Back From El Niño". Science. 288 (5468): 941a–942. doi:10.1126/science.288.5468.941a. PMID 10841705. S2CID 128503395.

ISBN: 978-93-90847-02-0

2. Response of Honeybees Against Cyanogenic Glycoside Present in Pollen and Nectar of (Clove) Syzygium Aromaticum (L.) Merr. & L.M. Perry & Pliny the Elder

Naira Nayab

Research Scholor,
Department of Botany,
Jai Prakash University,
Chhapra, Bihar.

Dr. Md Anzer Alam

Associate Professor,
Ganga Singh College,
Jai Prakash University,
Chhapra Bihar.

Abstract:

Some plants are poisonous in nature. Because they contain cyanogenic glycosides in their different parts. Cyanogenic glycosides are natural plant toxins. Due to the presence of this toxic compounds, plants may be harmful for herbivorous, insects and honeybees. The poisonous parts of plants are mainly seeds, leaves, flowers, pollen, and nectar...Etc. plant pollen is a male gametophytes and nectar is a sweet viscous secretion from the nectaries. plants which containing cyanoglycoside like S. aromaticum may be toxic for honeybees, Amygdalin also known as Laetrile, is a cyanogenic glycoside found in the pits of many fruits, in raw nuts, and in other plants such as lima beans, cloves, and sorghum. This study aimed to understand the response of honeybees against cyanogenic glycoside present in s. aromaticum. Our result suggests that clove nectar is not very much rich in amygdalin to pose a hazard, but that clove nectar could be toxic if exclusively consumed by honeybees for much more time. Further tests are needed to determine if honeybee's cloves herbs are at risk, or if they somehow cope with toxin.

Keywords: *S. aromaticum (Cloves), Amygdalin, nectar, pollen, and pollination.*

2.1 Introduction:

Pollination is a natural process found in angiospermic plants. The process of pollination is done by wind, various insects, butterflies and honeybees. Bees and flowering plants having a mutualistic relationship: the honeybees pollinate the plants and the plants provide nutrition to the bees in the form of nectar. Floral nectar, stored as honey. Honey is the main energy source for honeybees. Protein-rich pollen provides most of the nutrients like essential amino acids, lipids and vitamins required for honeybees in their physiological development.

Cyanogenic glycosides (CNglcs) are secondary metabolites widespread in plants.

CNglcs act as a plant defense: when a stabilizing glucose molecule is removed from the compounds by a catalyzing glucosidase enzyme into toxic hydrogen cyanide (HCN) is released and inhibits cellular respiration. Herbivores can overcome from this plant defensive compounds by detoxification, excretion or sequestration and can even use these compounds in their own defense against natural enemies. If CNglcs found in other organs of plants rather than pollen, there is no issue for honeybee's health. The nectar and pollen of S. aromaticum are known to have the bitter testing due to the presence of a little amount of compound amygdalin which is a cyanogenic glycosidic compound. Since chemical compound Amygdalin is a toxic cyanoglycoside compound so it can influence negatively on honeybees foraging at the flowers.

These problems were faced by some beekeepers and reported by them because they lost colonies because colonies using clove nectar for their feed. Due to all these problems, it is necessary to make initial studies on the toxicity on amygdalin on honeybees. A study on honeybees found that honeybees in 88% cases goes to take clove nectar and increases pollination and seed yielding 30-fold due to their activity. Several clove species produce in large quantities of nectar suitable for honey production. The aim of this study was to test the toxicity of amygdalin fed in sugar syrup on honeybees to determine if it poses a possible risk to bees keeping.

2.2 Materials and Methods:

Honeybees (*Apis mellifera ligustica*) were obtained from hives at RPCAU (Bihar) on 15 March 2020. Hording cages were taken (similar to those used by (Kulencevic and Rothenbuhler, 1973). hording cages were of wood, plexiglass, and screen with glass vial feeders in the top measuring 9 x 12 x 8cm, width, hight and depth. approximately 40 -70 bees were introduced into hording cages. Saturated sugar taken as per concentration. Cages were kept in laboratory in open conditions at temperatures that ranged from about 17.5 to 25C, and RH that ranged from about 18 to 37%.

Mortality of died bees was measured by counting on days 1,2,3,4,5,6,7and 8 days following initial dosing on day 0. *ad libitum* was an experimental solution which was used for bees feeding at the duration of experiments. *Ad libitum* having the property to stimulate feeding within the hive or at the flowers of blooming clove. Water was not provided.

The data were analyzed in SAS by proc PROBIT to determine the duration of exposure, in days, at each experimental dose of amygdalin that would be required to kill 50% of the bees (LT50). The data also were analyzed to provide estimates of the dose of amygdalin (ppm) that would kill 50% of the treated bees after different amounts of time (LD50). Analysis of controls to determine an LT50 provided a significant model but had 95% fiducial limits of 1 to infinity.

To refine this answer, we added control bees from 2 tests done in 2020. Although those tests were associated with other plants products, the controls (i.e., unspiked sugar syrup) were treated in exactly the same fashion as described for testing amygdalin.

Both of those earlier tests had 8 control cages that were observed for 14 days. The numbers in Table 1are the results from the analysis of 214 bees in 4 control cages from the amygdalin test combined with 702 bees from the tests in 2020.

2.3 Results:

Table 2.1: The estimated duration of exposure, in days, at each experimental dose of amygdalin required to kill 50% of the bees (LT50).

Dose of amygdalin (ppm)	Estimated time (days) for 50 % mortality	Lower (95) % fiducial limit	Upper (95)% fiducial limit
0[a]	16.1	14.2	19.4
2,250	4.6	3.0	6.3
4,500	2.7	1.7	3.6
9000	2.3	2.1	2.4
18000	1.9	1.7	2.0
36000	1.8	1.5	2.0

a. Estimates based on controls from several tests. See methods for details.

Table 2.2: Estimates of the dose of amygdalin (ppm) that would kill 50% of the treated bees after different amounts of time (LD50).

Treated bees after different amount of time (LT50).

Times Days			
1	Not estimated		
2	15,300	10,400	25,100
3	5,900	4,200	7,900
4	2,300	2,000	2,500
5	2,100	1,900	2,300
6	1,800	1,500	2,000
7	1,600	1,300	1,800

2.4 Discussion and Conclusion:

Our study shows that the rate of toxicity of amygdalin on honeybees (Apis mellifera ligustica). According to the results, it can be said that doses which are similar to those found in pollen nectar of S. aromaticum is not having much toxic effects to kill honeybees, but the pollen of S. aromaticum having sufficient amount of amygdalin and can be harmful for those bees consuming a pure diet over about a week.

It is considered that the Amygdalin - a toxic compound found in the nectar of clove maybe come through the pollen of clove due to the natural events.

It may be also possible that pollen grains fell into nectar of cloves due to natural events or by winds and due to this reasons amygdalin transferred into nectar of cloves. some organisms and insects are resistant to amygdalin because they have B-glucosidase enzymes that break it down. Pollen of cloves may be harmful for honeybees at that time when it gathered on flowers at the time of consumption of the floral resources of S. aromaticum, but when honeybees stored it in the hive the effect of toxin gradually decreased. In both conditions honeybee's colony consumed a large amount over a brief period of time. After few days the stored pollen detoxified gradually due to the effects of acidification in bee breads or by the dilutions with other pollens. And then the stores become non-toxic relatively. Water consumption in their diet may also influence the toxicity of secondary plants compounds including amygdalin. However, there is no documented indication that honeybees used for S. aromaticum pollination are harmful because of amygdalin which is found in their nectar. It is recommended to the commercial bee keeping industries to assess the impact and risk of amygdalin (found in pollen of S. aromatica) which give a toxic and harmful effects on the health of honey bees.

2.5 Acknowledgement:

We are very much thankful to RPCAU (Bihar) for access and collection of honeybees. We are also thankful of my department of Botany for providing necessary laboratory facilities and various supports during the study.

2.6 References:

1. Klein, A.-M.; Vaissiere, B.E.; Cane, J.H.; Steffan-Dewenter, I.; Cunningham, S.A.; Kremen, C.; Tscharntke, T. Importance of pollinators in changing landscapes for world crops. Proc. R. Soc. Lond. B Biol. Sci. 2007, 274, 303–313. [CrossRef] [PubMed]
2. Gallai, N.; Salles, J.-M.; Settele, J.; Vaissière, B.E. Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. Ecol. Econ. 2009, 68, 810–821. [CrossRef]
3. Brodschneider, R.; Crailsheim, K. Nutrition and health in honey bees. Apidologie 2010, 41, 278–294. [CrossRef]
4. Baker, H.G. Non-sugar chemical constituents of nectar. Apidologie 1977, 8, 349–356. [CrossRef]
5. Pentzold, S.; Zagrobelny, M.; Bjarnholt, N.; Kroymann, J.; Vogel, H.; Olsen, C.E.; Møller, B.L.; Bak, S.
6. Metabolism, excretion and avoidance of cyanogenic glucosides in insects with different feeding specialisations. Insect Biochem. Mol. Biol. 2015, 66, 119–128. [CrossRef] [PubMed]
7. cyanogenic glucoside defence. PLoS ONE 2014, 9, e91337. [CrossRef] [PubMed]
8. Adler, L.S. The ecological significance of toxic nectar. Oikos 2000, 91, 409–420. [CrossRef]
9. Hawkins, J.; De Vere,N.; Griffith, A.; Ford, C.R.; Allainguillaume, J.; Hegarty,M.J.; Baillie, L.; Adams-Groom, B.

10. Using DNA metabarcoding to identify the floral composition of honey: A new tool for investigating honey bee foraging.
11. Bruni, I.; Galimberti, A.; Caridi, L.; Scaccabarozzi, D.; DeMattia, F.; Casiraghi,M.; Labra,M. A DNA barcoding approach to identify plant species in multiflower honey. Food Chem. 2015, 170, 308–315. [CrossRef] [PubMed]
12. Thomson, J.D.; Draguleasa, M.A.; Tan, G.M. Flowers with caffeinated nectar receive more pollination Arthropod-Plant Interact. 2015, 9, 1–7. [CrossRef].
13. Cutler, G.C.; Rix, R.R. Can poisons stimulate bees? Appreciating the potential of hormesis in bee-pesticide research. Pest Manag. Sci. 2015, 71, 1368–1370.[CrossRef][PubMed].
14. Zagrobelny,M.; Bak, S.;Møller, B.L. Cyanogenesis in plants and arthropods. Phytochemistry 2008, 69, 1457–1468. [CrossRef] [PubMed]
15. Kjærgaard, T. A plant that changed the world: The rise and fall of clover 1000–2000. Landsc. Res. 2003, 28, 41–49. [CrossRef].
16. Duke, J.A. Handbook of Legumes of World Economic Importance; Plenum Press: New York, NY, USA; London, UK,1981.
17. Zagrobelny, M.; (University of Copenhagen, Copenhagen, Denmark). Personnal Communication, 2017.
18. 30. Lambert, J.L.; Ramasamy, J.; Paukstelis, J.V. Stable reagents for the colorimetric determination of cyanide by modified könig reactions. Anal. Chem. 1975, 47, 916–918. [CrossRef].
19. Cecen, S.; Gosterit, A.; Gurel, F. Pollination effects of the bumble bee and honey bee on white clover (Trifolium repens L.) seed production. J. Apic. Res. 2007, 46, 69–72. [CrossRef].
20. Møller, B.L. Functional diversifications of cyanogenic glucosides. Curr. Opin. Plant Biol. 2010, 13, 1–10. [CrossRef] [PubMed].

ISBN: 978-93-90847-02-0

3. The Nature and the Soil

Subhashini A.

Assistant Professor,
Government Law College,
Chengalpattu, TamilNadu.

Abstract:

This paper is mainly focused on the study of the significance of the important natural source i.e., SOIL- It is not a formal letter or a word, it's a life of the natural cycle of all living organisms. The soil itself creates a mountain, destroys sand, clay, and various sedimentary sources. Without soil, we can't imagine where the world will move. Soil is the elixir of nature.

Keywords: *Soil, Afforestation, Deforestation, Soil Erosion, Wetland soil and the ecosystem.*

Figure 3.1: SOIL- It's more Essential than you think:

In our day-to-day life, we have been going through so many communities of plants, animals and microbes, etc. but the question is do we think about how it all started and what is the root of all those living things?

There are so many natural resources which are helpful and essential to lead our day-to-day life. Despite all those resources Soil plays the role of heart of those all-natural resources.

Plants and animals rely on soils for food, shelter, and more. Soil is also home to fungi, algae, and unicellular and multicellular organisms that are invisible to the naked eye, such as bacteria and protozoa. As they move through the soil, microorganisms help improve drainage and soil structure, making soil more fertile and productive.

3.1 What is Soil?

Soils are complex mixtures of minerals, water, air, organic matter, and countless organisms that are the decaying remains of once-living things. It forms at the surface of land – known as the ***skin of the earth.*** Soil is proficient in supporting plant life and is vital to life on earth.

Soil is not only just a loose surface material that covers most lands but also it is home to more than 25 percent of our planet's biodiversity, it supports plant life, agriculture, and food security. Soil structure plays an indispensable role in plant growth helping in the movement of water, air, and nutrients to plants.

3.2 Plays a Prominent Role in our Health:

Soils are important for human health in plenty of ways. Soil biodiversity helps us to breathe, they can help control air quality and greenhouse gas emissions through carbon sequestration, which cleans the air for us to breathe. Most of the human nutrients are gain from the soil and the four major elements, H, O, C, and N, make up approximately 99% of the human body, and seven minor elements, Na, K, Ca, Mg, P, S, and Cl, make up another 0.9% of the body. Out of the approximately 29 elements considered essential for human life, 18 are either essential or beneficial to plants and are obtained from soil, and most of the other elements can be taken up from the soil by plants. Therefore, soils that provide a healthy, nutrient-rich growth medium for plants will result in plant tissues that contain most of the elements required for human life when the plants are consumed.(National Research Council, 2005)[1].

3.3 Afforestation- Plantation of Trees:

Afforestation is the process of introducing trees and tree seedlings to an area that has presently not been forested. Afforestation can be done through tree planting and seeding, naturally or artificially. The life cycle of forests is very long, and it is difficult to change them once afforested. Forest sites are mainly affected by environmental and human activities.To facilitate afforestation, it is necessary to evaluate and classify the forest site factors and achieve a suitable species planted on the right site. Site preparation is also based on on-site classification. It is usually carried out after determining the type of afforestation land, divided into mechanical land preparation and chemical methods. An essential task of site preparation is to maintain soil moisture and promote seedlings survival and growth.

Afforestation of agricultural soils can result in important changes in physical characteristics of soil and soil structure formation in a relatively short time.

The pattern of changes and soil conditions in each phase depends on location, where microclimatic, geological, and biological factors and their interactions can play decisive roles. Based on our observations, the creation of a stable soil structure was related to the quality of soil organic matter, determined by the characteristics as well as the quantity of the litter.

Forest restoration is the method of improving the health, productivity, and arrangement of life of a forest is a complex endeavor that can never fully bring back the original forest.

That's why it's far better to conserve existing healthy forests and prevent them from being degraded or destroyed in the first place.

3.4 Deforestation- Devastation of Soil:

Deforestation can have destructive effects on soils. Soil is tied to the ground via the roots of plants. The huge roots of trees provide adequate facilities to prevent the topsoil from blowing away with the wind or washing away with the rain. When deforestation removes these trees and their roots the topsoil becomes vulnerable to the elements. Deforestation, as defined by the United Nations, is the permanent removal of trees until there is less than 10% of the forested land remaining.

Since the beginning of the Industrial Revolution, humans have removed more than half of the original forest cover on Earth. The effects of tree loss on soil are significant. Trees and shrubs shield the ground from the force of raindrops and provide shade that reduces surface soil temperature, which in turn reduces evaporation. Logging and small-scale removal of trees exposes soil to rain splash which loosens and dislodges soil particles, eroding soil and creating a more impermeable bare surface, which increases flow.

3.5 Soil Erosion and its Depravity:

Soil erosion is the most widespread form of soil degradation. It influences the productivity of natural and managed ecosystems. The natural wearing away of the soil surface by wind and water is worsened by poor soil management, especially in farmed lands. The slow replacement of eroded soil by the weathering of bedrock cannot keep up with rates of erosion caused by human action. Each year millions of hectares of farmland are lost to soil erosion, reducing the land available for agriculture.

The erosion, transport and deposition of eroded soils driven by cultivation and overgrazing cause a loss of nutrients and carbon in particulate forms. In turn, soil erosion leads to the pollution and sedimentation of waterways, and acts as a source of the greenhouse gases that contribute to climate change. The effects of soil erosion go beyond the loss of fertile land.

It has led to increased pollution and sedimentation in streams and rivers, clogging these waterways and causing declines in fish and other species. And degraded lands are also often less able to hold onto water, which can worsen flooding. Sustainable land use can help to reduce the impacts of agriculture and livestock, preventing soil degradation and erosion and the loss of valuable land to desertification.

A record from the (IPCC)[2] found that when cultivated without conservation practices, soil is currently eroding up to 100 times quicker than it's forming. The risk of erosion will become even higher in the future due to emissions-driven temperature changes, with resulting decreases in agricultural production, land value and human health.

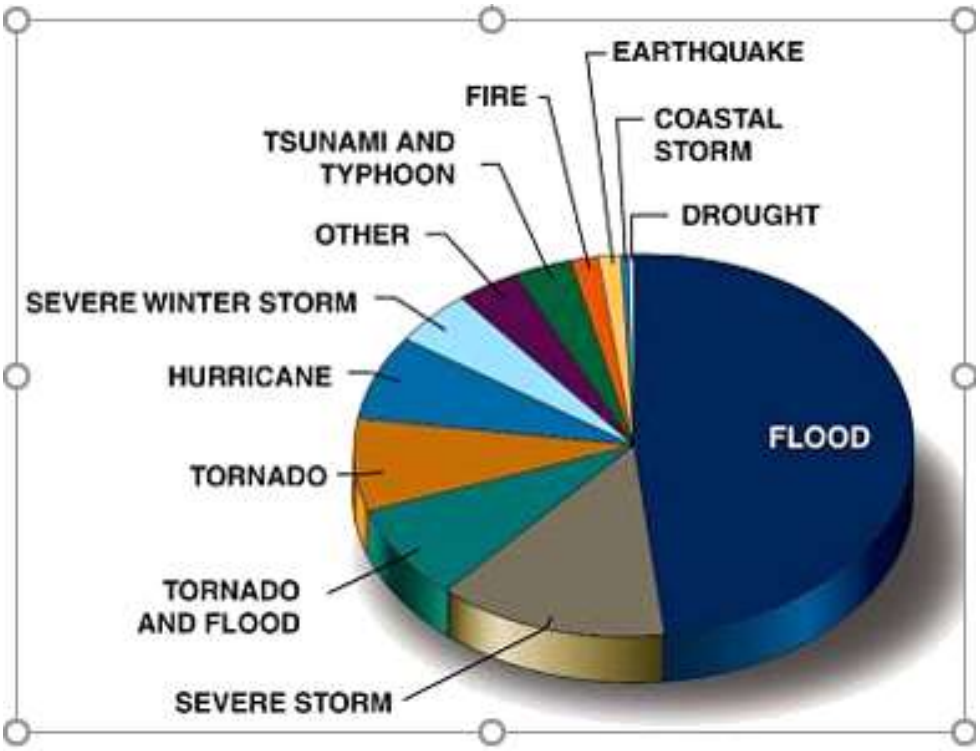


Figure 3.2: The pie chart bestows the factors which also cause soil degradation.

3.6 Wetland Soil and the Ecosystem:

Wetland soils differ from terrestrial soils in that they are anaerobic. The absence of oxygen produces characteristics, especially differences in soil color and texture that are uniquely different from aerobic, terrestrial soils. In anaerobic soils, a shift in microbial metabolism occurs, from one of aerobic, oxygen-driven metabolism to one driven by other energy-producing compounds. Wetlands are important features in the landscape that provide numerous beneficial services for people and fish and wildlife. Some of these services, or functions, include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters and maintaining surface water flow during dry periods. These valuable functions are the result of the unique natural characteristics of wetlands.

3.7 Wetland Soils:

Soils host the zone of biogeochemical activity where plants, animals, and microorganisms interact with the hydrologic cycle and other elemental cycles. A typical soil contains both mineral and organic materials as well as the adjacent water-filled and air-filled pore space.

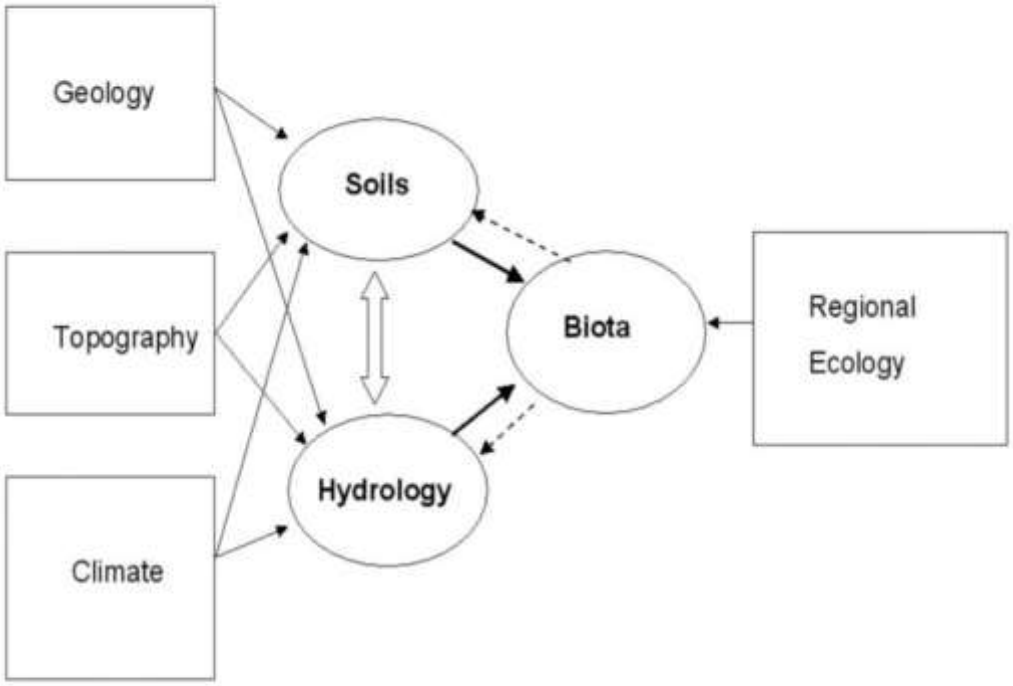
The physical and chemical properties of a soil may influence the processes that lead to wetland formation and function. Furthermore, wetland formation and function may influence some of the physical and chemical properties of soils. Bio-Geochemical processes in seasonally saturated soils can lead to the accumulation of organic matter and trans-formations of iron-based minerals, which may influence nutrient cycling, soil acidity, and soil color.

3.8 Generally, Wetland Soils can be Classified into three Categories:

a. Soils permanently inundated with water above the soil surface
b. Saturated soils with the water table at or just below the soil surface
c. Soils where the water table depth is always below the surface

3.9 Wetland Ecology:

Wetlands, which are fluctuating ecosystems inherently difficult to categorize, are often found at the intersection of terrestrial habitat and aquatic habitat and usually include elements of both systems. Biotic[3] and Abiotic[4] factors that are determined by hydrology in a wetland could include soil texture, water quality, or topography, whereas biotic factors influenced by hydrology in a wetland would be plant and animal types, diversity, or quantity.



Abiotic and biotic impacts upon and interactions within wetlands

3.10 Soil is Life, Conserve it:

Soil is the basis for sustenance for 7.9 billion people. Soil conservation is important for sustainability. It preserves clean water and helps regulate the climate. Soil loss translates into widespread poverty and slower economic development. Environmental and economic benefits, coupled with mandatory regulations, are strong incentives for producers to take every practical measure possible to protect the soil. Without soil conservation, soil erosion would increase. The effects of soil erosion go beyond the loss of fertile land impacts and m down the markets worldwide and also includes water usage.

Wendell Berry[3], the American novelist said that the soil is the great connector of lives, the source and destination of all. It is the healer and restorer and resurrect or, by which disease passes into health, age into youth, death into life. Without proper care for it we can have no community, because without proper care for it we can have no life. ***'Though researchers preach the importance of soil, most of us don't bother about it. We need to pay additional attention to conserve soil for our sake'.***

3.11 References:

1. Combs 2005; Committee on Minerals and Toxic Substances in Diets and Water for Animals, National Research Council, 2005).
2. https://www.nap.edu/initiative/committee-on-minerals-and-toxic-substances-in-diets-and-water-for-animals
3. Intergovernmental Panel on Climate Change (IPCC)
4. https://www.ipcc.ch/site/assets/uploads/2019/08/4.-SPM_Approved_Microsite_FINAL.pdf
5. World Resources Institute - Causes and effects of soil erosion
6. By Dede Sulaeman and Thomas Westhoff
7. https://www.wri.org/insights/causes-and-effects-soil-erosion-and-how- prevent-it

ISBN: 978-93-90847-02-0

4. Suggestive Eco-Friendly Approaches for Solid Waste Management

Dr. Utpal Goswami

Lecturer,
Govt. Banikanta College of Teacher Education,
Lachit Nagar, Guwahati, Assam.

Abstract:

With the rapid growth of population and industrialization, the production of waste is rising at an alarming rate in urban areas. Human activities generate considerable amount of solid waste. The indigenous practice in this regard is generally found to be open dumping and door-to-door collection by the municipal authorities. Environmental degradation is always accompanied by the commonly practiced ways of solid waste disposal. Hence, environmentally sound solid waste management strategies and techniques are required for the effectiveness of the urban solid waste management. The traditional methods used for solid waste management practices are associated with the environmental pollution problems such as air, water and soil pollution. It is possible to implement certain corrective measures during collection, storage, transport and disposal of urban solid waste so as to minimize the adverse impacts on the environment.

The problem of waste management can be mitigated through adoption of improved methods of collection, transportation and active community involvement. Moreover, scientific and environment friendly technologies for disposing should be encouraged. Technologies such as composting, vermicomposting, biomethanation, fuel pelletisation, landfill gas technology, energy recovery through processing can assist in proper tackling of solid wastes. Recycling activities and advanced technologies can ensure the reduction of the quantity of waste to be finally dumped besides generation of substantial amount of energy, electricity and manures. In this regard, municipalities, private entrepreneurs, NGOs and active participation of local residents is also necessary so as to achieve environmental sustainability in the long run.

Keywords: *Urban solid waste, Biomethanation, Composting, Fuel pelletisation, Landfill gas technology.*

4.1 Introduction:

The large quantity of solid waste generation has posed a serious threat to the ecology and environment of urban areas. Solid wastes include all the wastes in solid form arising from normal human and animal activities and which are discarded as useless or unwanted. Solid waste arising from human activity has become one of the major environmental problems in the present period of time causing extensive pollution and threat to human health. Piles of garbage and wastes of all kinds littered everywhere have become common sight in urban areas.

Solid waste generated by domestic, commercial and industrial activities are often indiscriminately disposed. It is common to find large heaps of garbage in disorganised manner at every nook and corner in most of the urban areas. The absence of adequate waste disposal system is a perpetual environmental hazard in cities and towns. The problem is further aggravated due to the non-biodegradable nature of plastic and polymeric materials. At present, solid waste pollution is regarded as third pollution after air and water pollution from the viewpoint of importance and significance.

There is a growing realization that the environment has limited assimilative and carrying capacity. This means that pollution control is essential in order to safeguard the environment and hence the quality of life. Waste, if not properly treated and handled, not only threatens human life in short term, but the environment as a whole in the long run. Therefore, it is necessary to implement suitable strategies for the management of solid wastes.

4.2 Common Indigenous Disposal Practices of Solid Wastes:

In urban areas, in most of the parts of India the open dumping is the common practice adopted by the people for the disposal of solid wastes, also known as garbage. However, the door-to-door collection and disposal at a common dumping site authorized by the municipal authorities is also seen in several urban areas. Open dumping observed at several streets of the cities is an eyesore destructing the natural beauty the city. Although sanitary landfilling method of disposal is not practiced for final disposal of solid waste in most cities and towns, however it can be regarded as better mode of non-recyclable waste disposal than the existing open dumping method. In order to combat garbage menace in cities, towns and some polluted rural areas of the country, several management practices can be adopted for the effective handling of solid wastes. These strategies are illuminated in the following heading.

4.3 Management Strategies:

The present and future ways to manage solid waste need consideration on the following points – upgradation of the waste collection, transportation and disposal practices, setting targets for waste reduction, technological intervention and recycling activity, institutional and regulatory reforms. Segregation and storage are the key factor for waste utilization and recycling. It is an essential part of the preliminary phase of waste management. To promote the practice of segregation the community awareness programmes have to be undertaken. A two-bin system of solid waste storage should be introduced for segregation at source. The bio-degradable and non-biodegradable waste can be separately placed in these two bins. The segregated waste so stored in these bins will have to be transferred to community collection point or to the municipal vehicle separately. Proper segregation of waste into different components and their separate collection can definitely lead to remarkable changes in the entire system. For primary collection, door-to-door collection is regarded as the best option all over the world. With the introduction of segregated waste storage, it can be possible to introduce a system in which different categories of wastes are collected on different days and at varying intervals from the point of generation. Collection of hazardous municipal waste such as infectious bio-medical solid waste should be strictly carried in covered container.

Proper segregation will lead to better opportunity for scientific disposal of waste. The recyclables should be straightway transported to recycling units. This will help in motivating and activating the recycling units and this in turn can lead to several advantages such as enabling technology upgradation, better quality products and saving of valuable raw material resources of country. The biodegradable matter can be disposed either by aerobic composting, anaerobic digestion or sanitary landfilling. Depending upon the land availability and financial resources either of these disposal methods can be adopted.

Source reduction is an effective way for solid waste menace. The less one has to deal with, the easier and convenient is the waste disposal. It includes both minimizing the amount of solid waste and reducing the waste toxicity. There are a number of ways by which waste generation can be minimized by its use or recycling. If it is not possible to reuse or recycle, the waste can be disposed of safely by methods like sanitary landfilling, incineration, pyrolysis etc. The appropriate technology for solid waste disposal reduces not only the quantity of waste but also improves the quality of waste to meet the required pollution standard. At the same time, substantial economy can be recovered in the form of energy and manures.

Various technological approaches that can be met for urban solid waste management are – (i) Composting (ii) Biomethanation (iii) Fuel pelletisation (iv) Energy recovery from refuse (v) Landfill gas technology etc.

Composting is the biological decomposition and stabilization of organic substrates. The processing of refuse may be done by composting and the end product is used as manure in agriculture. The key areas for consumption of compost made from city waste are – agriculture, land scaping, horticulture, bioremediation, aquaculture, afforestation, land restoration etc. As the required (Carbon : Nitrogen) ratio and organisms which are decomposing the organic matter are present in urban solid waste, composting is suitable for refuse management.

Vermicomposting is a process of using earthworms for conversion of biodegradable wastes into compost. This method of composting can be practiced widely at orchard, farm and small-scale decentralized community composting.

Biomethanation is one of the most innovative techniques in which resource recovery is in the form of biogas and organic manure. The biogas can be used for heating or power generation whereas the sludge from treatment plant is used as organic manure. Economic recovery in the form of biogas and organic manure provides good prospects for self-sustainability of the treatment plant.

Fuel pelletisation is the process of production of fuel pellets from solid waste. The pelletisation technology involves drying, removal of non- combustibles, grinding, mixing and production of pellets. Fuel pellets or refuse derived fuel (RDF) can be used as a fuel for heating plants, boilers, for generation of steam which can be used for generation of powers.

By adopting recent technologies energy recovery is possible from refuse as a by-product in waste treatment process.

These are various technologies like incineration, pelletisation, pyrolysis and sanitary landfilling etc. for energy recovery from the refuse. It is estimated that over 1000 MW power can be generated from the solid waste of India through adoption of waste recycling technologies.

The landfill gas technology can very effectively be utilized for disposing garbage that has relatively high organic contents. In this technology, landfill sites act as a bioreactor in which gas is generated by decomposition of organic matter. It has been estimated that over a period of 10 years, one ton of solid waste can produce more than 100 times its volume. The gas consists of mainly methane and carbon dioxide. It is worthwhile to recover energy when methane gas concentration is high.

The non-biodegradable plastic waste can be also recycled to produce various value-added products. Moreover, the plastic waste can be used for electricity generation, road construction etc. Scientists have also reported the possibility of applications of the plastic wastes to harness sunlight as well as conversion into petrol and probability of biodegradation of polluting plastics using carbohydrate and bacteria.

The municipalities are the primary institutions responsible for solid waste management in our country. However, it is also necessary to harness and integrate the role of private sector, NGOs and waste workers in this field so that the solid waste management practices become totally effective. In the context of solid waste management, private entrepreneurs are gaining entry into the waste collection, transport activities and treatment processes. Private companies can efficiently carry out secondary collection and transport of garbage including vehicle maintenance. The NGOs can help the rag pickers to form waste management associations / groups under the supervision of the local body and relevant residents or market associations. The Municipal Solid Waste (Management and Handling) rules, 2000 (revised in 2016) published by the Ministry of Environment and Forests, Govt. of India apply to every municipal authority responsible for collection, segregation, storage, transportation, disposal and processing of municipal solid wastes. Therefore, urgent implementation of the relevant agenda, regulatory reforms are essential for solid waste management system. The formulation of detailed technical and operational standards relating to handling and disposal of solid waste can show the pathway of proper and uniform planning for urban solid waste management. This can also ensure the environmental sustainability in the long run.

4.4 Conclusion:

The solid waste management has emerged as a major environmental issue in the urban areas. The unscientific and uncontrolled method of urban solid waste disposal can create severe pollution in terms of environmental degradation. The indigenous practices adopted by local people in the context of solid waste disposal is found to be unscientific and unhygienic at many regions of our country. The recycling activities, source reduction and adoption of suitable waste processing technologies should be encouraged to tackle the overwhelming menace. Moreover, the modern technological approaches such as Remote Sensing and GIS technique should be assisted so as to streamline the collection and transportation of solid waste with improved efficiency.

Active participation of local authorities, private sectors, NGOs are necessary, and a systematic approach needs to be adopted for optimizing the entire operation of solid waste management encompassing segregation at source, timely and properly collection, transportation routes, proper operation of sanitary landfill sites etc. Rather than considering the urban solid waste simply as a residue to be thrown away, it should be recognized as a resource material for the production of energy, compost and fuel depending upon the techno-economic viability, local conditions and achieving environmental sustainability for future period of time.

4.5 References:

1. Bhuyan Kabita, 1999. Waste management practices in rural households of Assam, Ecology, Environment and Conservation 5(4): 395-397.
2. Dhande, A.D., Sopan T. Ingle, 2005. Ecofriendly approach of urban solid waste management: A case study of Jalgaon city, Maharashtra, Journal of Environmental Biology, 26 (4): 747-752.
3. Kharbanda, O.P. and Stallworthy, E.A. 1990. Waste management, Grower Publishing Co Ltd., P.30-39.
4. Kumar Pramod and Singh C.P. 1999. Managing solid waste: A case study of Ghazipur city, J. Enviromedia. Poll Res. 18(3):231-234.
5. Malviya, R., Choudhary, R. and Buddhi, D. 2002. Study on solid waste assessment and management – Indore city, IJEP 22 (8): 841-846.
6. Ramachandra, T.V. and Varghese Saira, 2003. Exploring possibility of achieving sustainability in solid waste management, Indian J. Environmental Health, 45(4): 255-264.
7. Renjini and Prakasham, V.R. 2005. Evaluation of municipal solid waste management in punithura municipality of Kerala, IJEP 25(7): 652-656.
8. Veeramani, M. and Selvakumar, N. 2001. Waste management systems, J. Enviromedia. Poll Res. 22(1):87-91.

ISBN: 978-93-90847-02-0

5. Water Pollution

Dr. Rajabhuvaneswari Ariyamuthu

Assistant Professor,
Srisairam Institute of Technology, Chennai.

5.1 Introduction:

Water pollution is one of the greatest crises facing the country. The largest source of it is the sewage water without treatment, as also water coming from pesticides-ridden fields, and chemical waste producing small and big industries. In addition to the acute problems of water pollution in developing countries, developed countries also continue to struggle with pollution problems.

5.2 Definition:

Water pollution may be defined as, “the alteration in physical, chemical and biological characteristics of water making it unsuitable for designated use in its natural state. which may cause harmful effects on humans and aquatic life.

The Contamination of water with undesirable substances which make it unfit for usage is termed water Pollution. “The pollutants include sewage, industrial chemicals and effluents, oil and other wastes.

Besides, chemicals from the air dissolved in rainwater, and fertilizers, pesticides and herbicides leached from the land also pollute water. Addition of certain substances such as organic, inorganic, biological and radiological to the water, which degrades the water quality and makes it unhealthy for use.

5.3 Sources of Water Pollution:

5.3.1 Point Sources:

Point sources of pollution occur when harmful substances are emitted directly into a body of water. Major point sources are industries, power plants, underground coal mines, offshore oils wells etc.

5.3.2 Non-Point Sources:

Nonpoint sources deliver pollutants indirectly through environmental changes.

Surface run off from agricultural fields, overflowing small drains, rain water sweeping roads and fields, atmospheric deposition etc. It is much more difficult to control. Pollution arising from non-point sources accounts for a majority of the contaminants in streams and lakes.

5.4 Types of Water Pollution:

5.4.1 Ground Water Pollution:

Groundwater- 6.2 % of total water, 30 times more than surface water. Seems less prone to pollution as soil retains contaminants due to CATION EXCHANGE CAPACITY.

But there are a number of potential sources like septic tanks, industry, deep well injection, mining etc responsible for ground water pollution which is IRREVERSIBLE.

Ground water pollution with arsenic, fluoride and nitrate are posing serious health hazards

5.4.2 Surface Water Pollution:

a. Sewage
b. Industrial effluents
c. Synthetic detergents
d. Agrochemicals
e. Oil

5.4.3 Domestic Sewage:

a. Refers to wastewater that is discarded from households. Also referred to as sanitary sewage, such water contains a wide variety of dissolved and suspended impurities.
b. It is large by volume and contains impurities such as organic materials and plant nutrients that tend to rot.
c. The main organic materials are food and vegetable waste, plant nutrient come from chemical soaps, washing powders, etc.
d. Domestic sewage is also very likely to contain disease-causing microbes.

i. Industrial Effluents:

- Wastewater from manufacturing or chemical processes in industries
- Industrial wastewater usually contains specific and readily identifiable chemical compounds.
- Mainly in the form of toxic wastes and organic pollutants.
- Chromium, mercury, lead, copper, cadmium etc.

ii. Synthetic Detergents and Oils:

- Added because of washing clothes, cleaning utensils.
- In industries for washing
- Add surfactants and soaps to water
- Toxic to fish, aquatic life.
- Oceans are polluted by oil on a daily basis from oil spills, routine shipping, run-offs and dumping.

- Oil spills make up about 12 to 15% of the oil that enters the ocean. The rest come from shipping travel, drains and dumping.

iii. Agrochemicals:

- Routine applications of fertilizers and pesticides for agriculture and uncontrolled run off in water bodies.
- Adds Nitrogen and Phosphorus to water
- Causes Eutrophication and algal blooms.
- Nitrate concentration is above the permissible level of 25 ppm in 14 states, covering 102 districts.

iv. Ground Water Pollution:

- Septic tanks
- Mining
- Deep well injection
- Arsenic, Nitrate, Fluoride

v. Fluoride Poisoning:

- Fluoride when ingested in small quantities (<0.5 mg/L) is beneficial in promoting dental health by reducing dental caries, whereas higher concentrations (>1.5 mg/L) may cause fluorosis. Fluoride exposure in humans is related to (1) fluoride concentration in drinking water, (2) duration of consumption, and (3) climate of the area. In hotter climates where water consumption is greater, exposure doses of fluoride need to be modified based on mean fluoride intake. Various cost-effective and simple procedures for water defluorination techniques. The study investigated the geochemistry and occurrence of fluoride and its contamination in groundwater, human exposure, various adverse health effects, and possible remedial measures from fluoride toxicity effects.
- Fluoride had been reported to cause depressions in DNA and RNA synthesis in cultured cells and significant reductions in DNA and RNA levels in mice.
- Conditions including ageing, cancer, and arteriosclerosis are associated with DNA damage.

vi. Arsenic Poisoning:

- The recommends a limit of 0.01 mg/l of arsenic in drinking water. Exposure to high enough amounts of arsenic can be fatal.
- High levels of arsenic above the permissible levels of 50 parts per billion (ppb) are found in the alluvial plains of Ganges covering six districts of West Bengal.
- Ground water continues to be the most common source of arsenic poisoning. One of the most effective preventive measures against arsenic poisoning is to make sure you drink clean, filtered water. Arsenic contamination of drinking water causes a disease called arsenicosis, for which there is no effective treatment.

- There's no specific method used to treat arsenic poisoning. The best way to treat the condition is to eliminate arsenic exposure.

vii. Effects:

- Depletion of dissolved oxygen
- Eutrophication
- Biomagnification
- Blue baby Syndrome
- Minamata disease
- Pathogen spreading diseases
- Genetic deformities

viii. Marine Pollution:

- River discharge, manmade pollution and oil spills etc.
- An excessive amount of mercury in water can cause Minamata disease in humans and dropsy in fishes; Lead in large amount can cause dyslexia,
- Polluted water has less amount of Dissolved oxygen (DO) content which is important for sensitive organisms, thereby eliminates sensitive organisms.
- Excess of nitrate in drinking water is dangerous for infants and human health, excess fluoride causes neuromuscular disorder and teeth deformity, hardening of bones and painful joints.
- Biological magnification and eutrophication occur.

ix. Control Measures of Water Pollution:

- Usage of water should be minimized by changing the techniques involved.
- Recycling and Treatment of water before leaving in water bodies.
- The quantity of discharge of wastewater can be minimized and Restoration of polluted water bodies.
- Excessive use of fertilizers and pesticides should be avoided.
- Organic farming should be increased.
- Judicious use of agrochemicals. Avoid use of these on sloped lands.
- Using Nitrogen fixing plant instead of fertilizers.
- Reducing pesticides by adopting integrated pest management.
- Prevent run-off of manure. Divert run-off to basin for settlement.
- Separate drainage for sewage and rain water to prevent overflow of sewage with rain water.
- Planting trees will reduce pollution by sediments and will prevent soil erosion.
- Total solids, BOD, Chemical Oxygen Demand (COD), nitrates & phosphates, oil & grease, toxic metals etc.
- Primary & secondary treatment reduce BOD, COD levels.
- Advanced treatment removal of nitrates & phosphates will prevent eutrophication.

5.5 Water Quality Standards:

a. INDIAN STANDARD INSTITUTION—ISI
b. WORLD HEALTH ORGANISATION—WHO
c. INDIAN COUNCIL OF MEDICAL RESEARCH—ICMR
d. UNITED STATES PUBLIC HEALTH SERVICE—USPHS

ISBN: 978-93-90847-02-0

6. Muga Silkworm: An Approach towards Climate Resilient Sericulture for Promoting Sustainable Development

Bhuyan Pinky Moni

The Assam Kaziranga University,
Jorhat, Assam.

Nath Pranab Kumar

Assam Agricultural University,
Jorhat, Assam.

Devid Kardong

Dibrugarh University,
Dibrugarh, Assam.

Gogoi Dip Kumar

Central Silk Board,
Government of India.

6.1 Introduction:

Muga silk fabric has been a vital part of the Assamese culture from time immemorial. As evident from Kautilya's 'Arthasastra' and Edward A. Gait's 'A History of Assam', Muga-silk has been adored for ages (Baruah, 2017). Muga silk is produced from Muga silkworms (*Antheraea assamensis* Helfer) that belong to non-mulberry, or Vanya silk and is mostly wild unlike mulberry silkworm-the domesticated counterpart. This variety of silk moth is monospecies and exclusively confined to the Brahmaputra valley of Assam, and the adjoining hilly area of North-east India- a part of the Indo Burma mega-biodiversity Hotspot (Myers et al., 2000; Chowdhury 1982). Muga silk was assigned Geographical indication (GI) tag in 2007.

The exquisite and shimmering golden silk has attracted global attention for centuries. Muga had put Assam on the famous silk route attracting consumers from far beyond and has helped secure remarkable status in the Silk map of the world. Currently, the state Assam produces 87% of India's silk production and much of it is contributed by muga silk.

In the recent years, silk has been widely used in bioengineering applications. This is owing to the improved biocompatibility with nominal adverse reactions in vivo, optimized physico-mechanical properties mimicking those of target tissues, ease of developing to meet cellular architectures as well as biodegradability, (Kundu et al., 2014; Gogoi et al., 2014). In addition, Muga silk has found application as nanomaterials (Asapur et al., 2020).

The avenue is highly employment-oriented and requires low capital-input. Therefore, it is an excellent option for development strategies targeted to generate sustainable employment and entrepreneurial opportunities in the rural areas.

However, there is several bottlenecks towards up-scaling productivity to meet consumer demand. The primary reason is of course the ecological isolation, that makes Muga silkworms phylogenetically less adaptive (Tikader et al., 2013). Muga silkworm possesses little genetic variation among populations, and it is less resistant to infection (Arunkumar *et al.*, 201. In addition, intensive agricultural practises, shrinkage in host plant habitats, age-old package and practises and lack of scientific insight hinders Muga economy from growing.

This chapter describes the status of Muga silk, its applications and scopes of productivity improvement in terms of horizontal expansion of food plants, improved package of practices and emphasises on muga-gut biota as a key driver to possible application for climate reselient muga cultivation.

6.2 Muga Silkworm Habitat, Host Plants and Taxonomy:

Muga silkworm (chromosome number, n = 15) habitat extend from West Garo Hills district of Meghalaya stretching East ward to Karbi Anglong and Hill districts of Assam, down to the Mon district of Nagaland (25.5736°N, 93.2473°E). The confined geographical presence of Muga silkworms indicates its special requirement for productivity and survival. Such prerequisite includes high humid temperate climate, availability of different host plants and suitable pristine ambience.

Muga silkworm is a polyphagous phytophagous insect with about 22 host plant species (Nath et al., 2008). The choice of food plants of muga silkworms is governed by the presence of unique allelochemics such as alkaloids, tannins and terpenoids as well as benzyl isoquinoline (Peigler 1989, Geissman et al. 1969). Preferably it feeds on primary host plants like Som (*Persea bombycina* Kost.) and Solao (*Litsea monopetala* Roxb.). In absence of primary host plants, muga silkworm feeds on secondary host plants- Dighloti (*Litsea salicifolia* Roxb.) and Mejankori (*Litsea cubaba* Lour.). Some other food plants of muga silk belong to Lauraceae family- *Actinodaphnae obovata* Nees (Blume), *A. Anquistifolia* (Blume) Nees, *Cinnamomum glaucescans* (Nees) Drury, *C. glanduliferum* (Wallich) Meisner and *Litsea nitida* (Roxburgh) Hooker f. Some of the less preferred tree species includes *Celastrus monospermus* Roxburgh (Celastraceae), *Michelia champaca* L. (Magnoliaceae), *Magnolia sphenocarpa* Hooker F. and Thomson, *Zanthozylum rhesta* (Roxburgh) D.C. (Rutaceae), *Gmelia arborea* Roxburgh (Verbanaceae), and *Zizyphus jujuba* (Rhamnaceae) (Neog et al., 2006).

Kingdom: Animalia

Phylum: Euarthropoda

Class: Insecta

Order: Lepidoptera

Family: Saturniidae

Genus: Antheraea

Species: A. assamensis

Binomial name

Antheraea assamensis Helfer, 1837

6.3 Muga Silk and Socio-Economy of the Region:

From time immemorial, muga cultivation has been a mean of livelihood for many households. Muga silk industry is a prized export-oriented industry. Being endemic to the region, Muga silk has the potential to provide gainful occupation for rural mass and semi-urban areas of North-east Indian region. As per 2017-18 data, sericulture is practiced by more than 9935 villages and provides employment to more than 3.19 lakh families in Assam (Assam Economic Survey Report, 2017-18). During the time, amount of silk produced was 34.45 percent higher than the previous year (2016-17). The annual production of the Muga raw silk was about 233 MT in the year 2019–2020 (http://csb.gov.in/).

The export business of India from silk during 2008-09 (April-May) was worth Rs. 486.84 crore approximately and 429.88 crore in 2007-08 during the same period. The price per thousand of muga reeling cocoon, per KG of Muga Raw Silk (warf) and the weft has been Rs. 650.00, Rs. 5000.00 and Rs. 4500.00 respectively in the month of September 2008 at Sualkuchi Market while the price of the same in the previous year was Rs.600.00, 3900.00 and Rs. 3250.00 respectively (Phukan, 2012). At present, the business of Muga, the golden silk, is worth of Rs 200 crore. With proper management, the industry has potential to grow 10 times of its current size. In the international market price of muga silk is 242–346 US$ per kg raw silk (Central Silk Board, 2020) costliest among all silks produced in the world.

6.4 Cost Economics of Muga:

Muga cultivation is a labour-intensive practise as well as it requires larger farmland for host plants. The primary cost incurred during muga farming can be categorised into – Seed Cost, Labour cost, Depreciation cost, Expenditure on Host plants and related miscellaneous costs.

The income from sericulture can be categorised into return from Cocoon, seed cocoon, silk yarn as well as sell of garments. The gross cost per hectare in Muga cultivation is Rs. 8.05 Lakh including imputed labour cost and depreciation charges.

It is possible to earn net profit of Rs. 1.2 Lakh/ Hectare of muga farm with an ROI of 15.21% (Paul and Jena, 2017). Muga can be an attractive model for rural upliftment due to its high rate of return (Pandey, 2010).

6.5 Bottlenecks to Commercial Production and SWOT Analysis:

Muga cultivation has several bottlenecks that has caused its reduction. Following are the prime factors for it.

6.5.1 Ecological Factors:

Muga silkworm is semi-domestic in nature. From brushing to 5th instar stage, it is reared outside, while during cocooning, it is reared inside. The outdoor stage exposes silkworm larvae to nature's vagaries such as pests, predators and pathogens, seasonal fluctuation in temperature, rainfall, strong wind etc. inflecting heavy loss to the farmer (Barman and Ranjan, 2012).

6.5.2 Anthropological Factors:

Gradual land use change and shifting cultivation as well as increased use of pesticides has tremendously impacted muga silkworm. Moreover, various developmental activities as well as forest fragmentation has shirked muga habitat (Nath et al., 2008).

6.6 Traditional Rearing Practises:

Agricultural practises have been greatly benefiting from adoption of advancement of technological intervention and precision farming practises. However, Muga silk, being highly sensitive and semidomesticated nature, there exits several bottlenecks. Thus, there been little intervention from the scientific approach point of view. Muga-rearers even today do follow the age-old package and practises.

There is vast opportunity for addressing the woes of the sericulturists in terms of avoiding diseased Disease-Free-Laying (DFL), Nutrition management of host plant as well as the muga silkworms during active feeding stages and overall best practises to increase productivity.

SWOT matrix or SWOT analysis is a technique widely used in strategic planning and strategic management to identify strengths, weaknesses, opportunities, and threats related to business competition or project planning. It is also called situational assessment or analysis. For Muga farming, the SWOT matrix is as shown in Table 1.1.

Table 6.1: SWOT matrix of Muga farming in Assam

Strength	Weakness
• Supportive natural environment (soil, inclination, rainfall, etc.) for growth of som and sualu trees which is necessary for the muga silkworms to feed. • Access to indigenous knowledge, expertise, and skill	• Motivation among entrepreneurs • Lack of formal financial sources and Institutions • Smaller land holding

• Government policy crafted for handloom sector and area-specific schemes. • Easy availability of cheap labor with appropriate level of skill • Lower rate of investment and high rate of ROI and profitability • Growing demand.	• Age-old practises and lack of Scientific intervention. • Middlemen dominated supply-chain. • Lack of insurance, storing facilities, transportation, publicity etc. • Lack of centralized Muga silk processing facilities. • Absence of organized and regulated market. • Lack of forward linkage.
Opportunities	**Threat**
• Endemic nature of Muga • Growing market for hand-woven muga silk • Availability of online marketing channels • Promotion of Farmer Producer Companies (FPO) and supporting policies to safeguard the interest of the muga silk weavers.	• Natural environment and global warming. • Lack of open and regulated market • Competing agricultural practises • Rise in labour cost and unavailability of workforce.

6.7 Trends in Muga Productivity Enhancement:

6.7.1 Host Plant Propagation and Management:

One of the critical requirements in Muga farming is the healthy host plant. Som (*Persia bombycine*) and Soalu (*Litsaea polyantha* Juss)- the primarily host plants are propagated by seeds.

The seeds are sown in the nursery and is nurtured till ready to plant in the farmer's field. After systematic plantation in the field as per package and practise, it is essential for management of management of pest and disease of the host plants for profitable muga farming.

6.7.2 Improvement by Muga Breeding:

The genetic diversity of muga silkworm in culture rapidly decreases (Tikader et al., 2013).

Muga being found on host plants that differs by their abscission cycle, it influences Muga hibernation cycle (Kakati, 1991, 1993).

There exist several bottlenecks to improvement of Muga by breeding and there are not many reports available in this regard.

6.7.3 Indoor Rearing of Muga:

One of the primary reasons to loss in muga is due to its outdoor rearing mode. Out of the 5 to 6 broods, only the commercial cycle falls during favourable weather period, while the other crops fall prey to harsh weather.

Thus, there has been efforts to raise muga indoor. Such efforts include feeding host plant leaves in indoor conditions (Barman and Rana, 2011) as well as enhancing feeding behaviour in Muga silkworm by application of Nutrient Supplemented Phago-stimulants (Barman and Rajan, 2012). Muga silkworm grows till the 5^{th} instars in outdoor conditions after which it is maintained indoor. Thus, the prime motive behind indoor rearing is to support the early instars (till the onset of 3^{rd} instars).

6.7.4 Muga Artificial Diet:

Semi-synthetic diet for muga is an emerging field in Muga research. This has been tried by many researchers, however, has tremendous scope of improvement to be practically useful in commercial rearing practise. Saikia and Hazarika (2015) reported supporting larval growth using semi-synthetic Muga-diet. It is essential to know the chemical profile of Muga host plants for designing artificial diet. Neog et al., (2011) studied the phytochemicals present in Muga host plants.

They observed that β –sitosterol content in the tender leaves was significantly that β –sitosterol content is highest in tender leaves. The prime bottleneck during designing semi-synthetic diet is to prevent growth of pathogens on the diet while at the same time mimicking the natural flavour and nutrients in the diet to support growth of the insects. Successful recreation of natural host plant-like artificial diet is an opportunity towards climate resilient Muga farming.

6.7.5 Application of Beneficial Gut Microbiota in Silk Farming:

Another potential field of emerging research is the foliar application of beneficial bacteria *in-vitro* for supporting muga growth by helping digestion and resistance to pathogenic microbes. This research is in the nascent stage and has wide prospects towards improving rearing performance.

Bhuyan et. al., (2018) isolated cellulase degrading gut bacteria from Muga silkworm for potential application as foliar spray to help improving silkworm health thereby improving rearing performance. Gandotra et al., (2018) reported the presence of various digesting enzyme producing bacteria in the gut of healthy Muga silkworm.

6.7.6 Ecological Engineering:

In a broader perspective, ecological engineering involves the restoration of ecosystems that have been disturbed by human activities. The prime tools of ecological engineering are incorporation of biofertilizers, particularly mycorrhiza for improving soil health and help up taking critical macro and micronutrients by the crops (http://niphm.gov.in).

Restoring the natural condition helps orchestrating and reviving the productivity and strength within crops and that operational parameters and process configuration can act as selective forces on the community (Augelletti et al., 2019; Sree Latha and Jesu Rajan (2018). In terms of Muga silk, ecological engineering may include creating buffer zone to prevent reach of agrochemicals, plantation of healthy host trees and maintaining pristine condition in the surroundings.

6.8 Conclusion:

Muga rearing is a traditional practise with potential futuristic avenue for designing development strategies for the North-East India region.

However, there lies plenty of gap areas yet to be addressed to help the tradition to sustain and prevent being lost. Thus, there is dire need to adopt informed policy framing, calculated approaches and farsighted action plans to help Muga silk to reach the global stage.

6.9 Reference:

1. Arunkumar, P. K., Sahu, A.K., Mohanty, A. R., Awasthi, A. K., Pradeep, A.R., Rajeurs, S. and Nagaraju, J. (2012). Genetic diversity and population structure of Indian golden Silk moth. Plos one. 7(8): e43716.
2. Asapur, P., Banerjee, I., Sahare, P. D., and Mahapatra, S. (2021). Spectroscopic analysis of Muga silk nanoparticles synthesized by microwave method. Biotechnology and applied biochemistry, 68(2), 345-355.
3. Augelletti, F., Stenuit, B., Agathos, S. N., and Jousset, A. (2019). Manipulation of Biodiversity to Steer and Optimize Microbial Community Function.
4. Barman H, Rajan R. K (2012) Muga silkworm (*Antheraea assamensis* Helfer) indoor rearing by integrated "leaf freshness technology"- A new technology. African J. Agril. Res 7: 3490-3497 DOI: 10.5897/AJAR11.738.
5. Barman H and Rana B (2011) Early-stage indoor tray rearing of muga silkworm (antheraea assamensis helfer) – a comparative study in respect of larval characters. Mun. Ent. Zool 6: 262-267
6. Barman, H., and Rajan, R. K. (2012). Muga silkworm (*Antheraea assamensis* Helfer) indoor rearing by integrated leaf freshness technology-A new technology. African Journal of Agricultural Research, 7(23), 490-3497.
7. Baruah, M. (2017). At the frontier of imperial history: revisiting Edward Gait's A History of Assam. Asian Ethnicity, 18(4), 452-469.
8. Bhuyan, P. M., Sandilya, S. P., Nath, P. K., Gandotra, S., Subramanian, S., Kardong, D., and Gogoi, D. K. (2018). Optimization and characterization of extracellular cellulase produced by *Bacillus pumilus* MGB05 isolated from midgut of muga silkworm (*Antheraea assamensis* Helfer). Journal of Asia-Pacific Entomology, 21(4), 1171-1181.
9. Chowdhury, S.N. 1982. Muga Silk Industry. Directorate of Sericulture and Weaving, Govt. of Assam, pp.178
10. Gandotra, S., Kumar, A., Naga, K., Bhuyan, P. M., Gogoi, D. K., Sharma, K., and Subramanian, S. (2018). Bacterial community structure and diversity in the gut of the

muga silkworm, *Antheraea assamensis* (Lepidoptera: Saturniidae), from India. Insect molecular biology, 27(5), 603-619.
11. Geissman, T.A. and Crout, D.H.G. (1969). Organic Chemistry of Secondary Plant Metabolism. Freeman Copper and Co., San Francisco, pp. 592
12. Gogoi, D., Choudhury, A. J., Chutia, J., Pal, A. R., Khan, M., Choudhury, M., ... and Patil, D. S. (2014). Development of advanced antimicrobial and sterilized plasma polypropylene grafted muga (*Antheraea assama*) silk as suture biomaterial. Biopolymers, 101(4), 355-365.
13. Kakati P.K. 1991: Biology and bionomics of muga silkworm *Antheraea assama* Ww. (Saturniidae: Lepidoptera) with special emphasis on the economic in North east India. Ph.D. Thesis. Dibrugarh University, Assam.
14. Kakati P. K. (1993): Diapause strain of muga silkworm – an alternative to boost up muga industry. — Indian Silk 31: 22–25.
15. Kundu, B., Kurland, N. E., Bano, S., Patra, C., Engel, F. B., Yadavalli, V. K., and Kundu, S. C. (2014). Silk proteins for biomedical applications: Bioengineering perspectives. Progress in polymer science, 39(2), 251-267.
16. Myers, N., Russel, A. M., Cristina, G., Gustavo, F.A.B. and Kent, J. (2000). Biodiversity Hotspots for Conservation priorities. Nature. 403: 853-858.
17. Nath, R., Nath, S. K., and Devi, D. (2008). Study and conservation of host food plants of Muga silkworm, *Antheraea assamensis* (Helfer) of Assam. Nature Environment and Pollution Technology, 7(1), 83.
18. Neog K., Gogoi S. N., Chakravorty R. 2006. Present status and constraints of muga silkworm host plant germplasm conservation. In: Non-mulberry Silkworm and Host Plant Germplasm. pp 1-10. Central Muga Eri Research & Training Institute, Central Silk Board, Lahdoigarh, Jorhat.
19. Neog, K., Das, A., Unni, B. G., Ahmed, G. U., and Rajan, R. K. (2011). Studies on secondary metabolites of som (Persea bombycina Kost), a primary host plant of Muga silkworm (*Antheraea assamensis* Helfer). International J Pharmaceutical Science and Research, 3(3), 1441-1447.
20. Pandey, C., Das, K. K., & Roy, T. N. (2010). Economics of muga culture-a case study in Coochbehar district of West Bengal. Journal of Crop and Weed, 6(1), 17-21.
21. Paul, A., and Jena, S. K. (2017). Viability and prospects of muga silk cultivation in the lakhimpur district of Assam. International Journal of Business and General Management. 6(4), 33-44
22. Peigler, R.S. (1989). A revision of the Indo-Australian genus *Attacus* (Lepidoptera: Saturniidae). The Lepidoptera Research Foundation Inc., Beverly Hills, California XI, pp. 167.
23. Phukan, R. (2012). Muga silk industry of Assam in historical perspectives. Global Journal of Human-Social Science Research, 12(9-D).
24. Saikia, M. and Hazarika, L. K. (2015). Rearing performance of muga silkworm *Antheraea assama* Westwood (Lepidoptera: Saturniidae) on semi-synthetic diet. Journal of Experimental Zoology, India, 18(2), 825-829.
25. Sree Latha, E., and Jesu Rajan, S. (2018). Ecological engineering for sustainable agriculture: simple concept with greater impact. International Journal of scientific and research publications, 8(2), 123-125.
26. Tikader, A., Vijayan, K., and Saratchandra, B. (2013). Muga silkworm, Antheraea assamensis (Lepidoptera: Saturniidae)-an overview of distribution, biology and breeding. European Journal of Entomology, 110(2).

27. Tikader, A., Vijayan, K., and Saratchandra, B. (2013). Muga silkworm, *Antheraea assamensis* (Lepidoptera: Saturniidae)-an overview of distribution, biology and breeding. European Journal of Entomology, 110(2).

ISBN: 978-93-90847-02-0

7. The Politics of Democracy and its Connection with the Conservation of Biodiversity: A Research Project on Strategic Sustainable Development (SSD) to Connect the Geopolitics of International Relations with the Art of Biodiversity Conservation

Lopamudra Ghosh

Student (Fifth Semester) BA History (Honors).

Abstract:

Biodiversity, geopolitics, and international relations have important connections because more capitalism leads to more exploitation of wildlife resources, forest resources and natural resources which will be used more abundantly to meet the trade requirements of developed countries. And on the other hand, in order to survive economically and improve their living conditions and living standards, developing countries will continue to exploit biodiversity with a view of selling raw materials for manufacturing. If effective and all-inclusive conservation policies and agreements are not implemented, most of the biodiversity and natural resources we have will probably disappear, and after that globalization and capitalism have not much to do.

Eventually unless environmental problems become an integral part of the global agenda, the world will undergo major changes in the forms of climate change, and extinction of various rare species of flora and fauna, which will, in turn lead to the decline in the growth of biodiversity. Increasing human inhabitation is threatening biodiversity conservation practices and is also leading to the extinction of plant and animal species worldwide. This research argues that national political institutions, governmental institutions, and democratic institutions form an important platform for conservation. However, it has also discovered that the relationship between the democratic processes of these governmental institutions and the nation's efforts to create and track biodiversity remains unclear. In this article, key manuscripts have been reviewed to explain the doctrinal connection between democracy and biodiversity conservation.

While most studies report positive rather than negative interactions between democracy and biodiversity conservation, the most common result was a cohesive relationship which is often dependent on economic conditions. The research has found that the use of various proxies to measure biodiversity, including deforestation, protected areas, threatened species and fishing statistics emerged as the major barrier to biodiversity integration.

This research proposes to overcome this threat by presenting an all-inclusive definition of democratic institutions that cooperate with the stakeholders of biodiversity conservation to work in accordance with a guaranteed statistical framework of environmental governance. The article concludes by drafting some of the most important research priorities to improve policies against various biodiversity losses.

Keywords: *All-Inclusive Conservation Policies; Biodiversity Conservation; Capitalism; Democratic Institutions; Environmental Governance; Geopolitics; Governmental Institutions; International Relations.*

7.1 Introduction:

In the contemporary international politics, the most recent trend of global geopolitics emphasizes provincial behavior and the subsequent magnitude of the region, especially on regional and global scale.

The scope and focus of geopolitics however have changed over time to include the representation of the "*self*" and the "*other*", political actors, the material aspects of daily life, and the dissemination of issues affecting the emotional state of the people (making people feel one with their respective nation states) (Ekene 2019).

This hypothesis requires critical attention to the ways in which domestic policy becomes the geopolitical device that allows for the internationalization of local and national economies (Li and Jonas 2019, 70).

Given that the concept of geopolitics and the ideas and processes of conservation have changed over time, how do we find meaningful links between geopolitics and conservation of biodiversity? Another possibility is to consider the natural environment of the earth as a statecraft element (Won 2017).

We can also trace the ideas of geopolitics and its impact on protected areas over time. The most effective way is to use a variety of examples of protected areas to illustrate the link between conservation projects and the range of interests, as well as the subsequent power relations that open up conservation as a global project.

Conservation geopolitics is the latest addition to the broader discussion of natural geopolitics. Examples of that discussion include the study of polar geopolitics (Powell and Dods 2014) and natural disasters as a post-Cold War phenomenon characterized by a redefining of national security concepts (Dalby 1992).

However, the question of how this geopolitical lens improves our analysis of protected areas as the subject of geopolitical research has not been fully answered. In other words, the new geopolitics that seeks to construct assumptions with theoretical knowledge of empowerment processes at various sites (Tutuila and Dalby 1994, 514) has not yet been fully utilized in the study of protected areas as a national phenomenon.

Chaturvedi (1996, 3) is of the opinion that the new geopolitics provides opportunities to address questions related to the environmental and economic security in the context of a growing society. While concerns about safety issues are important to world peace, they often mask the subtle manifestations of political power in nature.

Take agreements and treaties to protect biodiversity through the establishment or enlargement of protected areas, which bring together weak and powerful states to agree on

common benefits. This inequality of power leads to the pursuit of national interests under the guise of global interest.

In Africa and elsewhere in the global South, conservation agreements need tools to fund and bind provinces, especially the release of land so that conservation often harms local people who depend on that land for their livelihood.

Geopolitics of protected areas is often reflected in the representation of environmental issues in the pursuit of provincial interests, in the way environmental news provides an opportunity to look at things while discriminating against others, and in the way, nature creates a global arena where international relations exist in either an engraved manner or a broken manner (O'Leary 2013).

In this research project, I have contributed to this field of work by analyzing protected areas as a place for political thinking and action. My premise is that protected areas act as axes of geopolitics and are a lens through which we can investigate ways in which environmental problems and solutions influence the interests of powerful regions, non-governmental organizations, and global capitalism. The following discussion shows how these characters perceive nature in ways that have a profound impact on the management of the environment. The actors create an environment that also produces natural boundaries such as unlimited, timeless and precious wilderness for protected areas by safeguarding the livelihoods of people, especially indigenous communities (Ramesside 2004; Guyot 2011).

7.2 Materials and Methods: Research Methodology:

The methodology for this research study involved three phases: Phase I, Phase II, and Phase III. In the Phase I, a literature review was steered along with exploratory interviews with actors in the fields of strategic sustainable development, conservation of biodiversity, global geopolitics, and peace work. From this, both theory and real-world examples were explored. In the Phase II of my research study, the materials and information gathered from both of the above-mentioned fields were linked to establish a conceptual framework. The results of this research are evaluated in the Phase III. The results were established based on the relations built between the conceptual framework (established in the Phase II) and the hypothetical deliberations (originally derived from the Phase I) in the field of geopolitics and its relationship with sustainable development which is supposed to be achieved by successfully practicing the art of biodiversity conservation. The results comprise the primary set of guiding principles and sustainable developmental strategies for employing a Strategic Sustainable Development (SSD) approach in conscripting a nation's foreign policy inclined towards the conservation of biodiversity.

7.3 Research Hypothesis:

In this research project, I propose to integrate the concept of telecommunication with the geopolitical approach, which focuses on the intangible power relations between nature reserves and how these relationships are built through long-term partnerships.

The general hypothesis of my research project is that the art of biodiversity conservation can be successfully practiced by focusing on governmental inputs from the geopolitical framework which can help to expose spatial performance as "*network effects*" but are actually "*flawed, incomplete and unstable*" approaches and strategies to conserve biodiversity (Painter 2009, 73).

I express the view that the disclosure of this network flexibility is an important aspect of the critical political process in protected areas.

I pursue this goal by investigating the impact of remote flows on the governance and management of Protected Areas (PAs) and the relationships between remote actors, national governments and local communities.

This research project is aimed at establishing a contextual analysis of the area of the border crossing "*W*" of the Tigris conservation complex which is named after the "W" curve of the Tigris River. The *W* complex has been repeatedly redesigned by locals, management systems and also by allowing cash flows, animal species, and human inhabitation since its creation in the 1950s.

7.4 Observations:

7.4.1 Discovery of the Politico-Economic Relationship between the Geopolitics of International Relations and the Art of Biodiversity Conservation: A Qualitative Analysis:

An ecologically protected frontier area is a colony between the remnants of the desert and civilization and is an active area where natural resources are considered the most important (Redcliff 2006; Guyot and Richard 2009; Heritier et al. 2009; Guyot 2011, 2017); Arnold de Sartre et al. 2012). As the name originally coined by the green community organization, an ecological frontier indirectly supports a local process that encourages people to conquer the endless, timeless and precious wilderness on behalf of many species in order to fulfill their aspirations for control and construction of the environment (Guyot 2011, 678).

It also draws attention to various and evolving political strategies that conserve the environment in time and space. An eco-frontier is a way of understanding the geopolitics of modern land consumption by natural actions and expressions. Eco-frontiers magnify the environment, and in so doing lead to geopolitical conflicts (Guyot 2011).

This political aspect of environmental control is often hidden under other requirements and can be fully explained by post-Foucauldian ideas of eco-governmentality and the environment (Hebden 2006), which integrate political environmental issues and important geopolitics. This part of the forum contributes to the "*Eco-Frontier Theory*" by analyzing the corresponding evolution of local production and its environmental support.

Eco-governmentality is partly based on Foucault's vision of governance (Foucault 2004) that incorporates the concepts of biological power and government in the analysis of social cohesion in the natural world (Guyot 2017, 24).

It is based on Foucault's assessment of regions with a focus on environmental thought and governance technology (Mallette 2009). Scientists have also considered environmental governance as a natural process that integrates many aspects of the current global control system (Luke 1999, 2000; Bryant 2002; Hebden 2006; Guyot 2015, 2017).

For its part, the environment is defined as "*the process by which a natural state constructs the concept of the environment while also determining the conditions necessary for that environment in order to maintain their political systems*" (Guyot 2017, 25).

Agrawal (2005) emphasizes that part of these conditions lies in the representation of natural agents among many people. Clearly, an eco-frontier is a local process that incorporates certain forms of natural politics. In fact, the eco-frontier is driven by nature in two related contexts.

The first involves a case in which a government agency or international environmental NGOs use science to justify the creation and management of protected areas. This ultimately leads to determining, for example, park areas and boundaries, to ensure some form of dominance over the area in these NGOs.

In the second case, low-level environmental agents strive to feel their natural boundaries by creating ecosystems, various ecosystems or environmental education programs, where disciplinary standards are at stake (Guyot 2017). The eco-frontier therefore reflects the local impact of the hidden species of nature.

7.4.2 The Politics of Democracy and its Connection with the Conservation of Biodiversity:

In literature, communication between nature and the environment is complex and often reinforces internal and cultural differences. Dualism exists among the ideas of a place-to-place nature. There are two key elements in the analysis of this division. The first focuses on the timeless, eternal, precious and non-human nature, the wilderness, the scope, and the sustainable developmental relationships with the eco-tone features.

The second not only captures the geographical details of the limited, appreciated and human-controlled ecosystems but also focuses on the design of designated and natural habitats with green belts, protected areas, nature corridors, endangered areas and a range of natural areas (Guyot 2011).

These two perspectives are puzzling because they do not pay much attention to the evolution of natural systems. They also overstep the bounds of ecosystems and the human diversity of life and space. Although the desert is intended to remain a wild and uninhabited place in its original state, no space in the world meets such a strong definition.

Alternatively, a protected area such as a national park is regarded as a "*land and/or marine environment dedicated primarily to the protection and conservation of biodiversity and to be managed in a lawful or effective manner*" (IUCN 1994). The fact is that tourism and recreation often take the place of nature in small parks and agricultural systems.

Ecotourism represents modern forms of elitist movement and discards the infinite size of protected areas. Ironically, it does this while preventing the ancient ecological movement of local residents (Guyot 2015). The concept of eco-frontier defines these two by presenting them as a process of environmental management and architecture.

The eco-frontier can embrace the whole eco-conquest process, both psychologically and geographically, without limiting its temporal size (Guyot and Richard 2009). It represents both a local and a temporary concept in which new forces constantly revisit old processes. Both variables are embedded in the "*Eco Frontier Concept*" of conquest, and both define the current natural conditions for political control over the environment.

7.5 Results and Discussion:

7.5.1 Sustainable Development and Biodiversity Conservation in Cross-Border Ecologically Protected Zones: Socio-Economic, Geopolitical, and Foreign Policy Perspectives:

Global social and economic trade has led to a steady increase in the flow of people, information and commodities. In this context, the interaction between remote points on the globe is much greater than ever before (Liu et al. 2007).

Researchers from the field of global system science have proposed the concept of telecommunications to address the socio-economic and environmental interactions in the range of social and environmental systems (Liu et al. 2013).

For example, they have shown how the demand for international soybeans has led to the transformation of the forest into a vegetation area in South America (Gasparro and Le Polzin de Watrous 2015).

The socio-economic, geopolitical, and foreign policy perspectives take social and environmental connections as a starting point and examine the flow of goods, species and forces within them; identification of agents, causal and effect relationships, and flow-related "*spillover*" programs (Liu et al. 2013). The advantage of this approach in relation to the general approach to global trade is that remote, interconnected systems are an integral part of analysis, making it possible to identify key stakeholders and their processes and conversion options.

However, this framework does not expose the broader effects of long-term interaction in society and the environment in terms of power, control and unequal results. For this reason, several researchers of these domains have proposed an additional heuristic communication system that integrates institutions, player networks and management systems to make power relations in decision-making at all levels more transparent (Frias et al. 2015; Eakin et al. 2017, Ober et al. 2018).

In this research project, I propose to integrate the concept of telecommunication with the geopolitical approach, which focuses on the intangible power relations between nature reserves and how these relationships are built through long-term partnerships.

The general hypothesis of my research project is that the art of biodiversity conservation can be successfully practiced by focusing on governmental inputs from the geopolitical framework which can help to expose spatial performance as "*network effects*" but are actually "*flawed, incomplete and unstable*" approaches and strategies to conserve biodiversity (Painter 2009, 73).

I express the view that the disclosure of this network flexibility is an important aspect of the critical political process in protected areas. I pursue this goal by investigating the impact of remote flows on the governance and management of Protected Areas (PAs) and the relationships between remote actors, national governments and local communities.

This research project is aimed at establishing a contextual analysis of the area of the border crossing "*W*" of the Tigris conservation complex which is named after the "W" curve of the Tigris River. The W complex has been repeatedly redesigned by locals, management systems and also by allowing cash flows, animal species, and human inhabitation since its creation in the 1950s.

7.5.2 Geopolitics of the Welfare State Versus Welfare Geopolitics: Contemplating the Loss of Biodiversity and Unsustainable Development as the Direct Consequences of the Conflict between Geopolitics of the Welfare State and Welfare Geopolitics:

A major revolution took place in 2003 and was driven by what some have called "*traditional freedom*" (Webber 2011). Supported by all indigenous groups from the oriental to the occidental, the leader of the Coca Producers' Union and the MAS political party, Evo Morales, came to power in 2006 defending "*indigenous*" national identity and moral values with an aim of safeguarding our mother earth ("*Pachamama*").

His early reforms clearly show his solidarity with the Andean settlement and the "*Cocalero Movement*". A new agricultural reform law (*Ley de Reconducción Communitaria de la Reforma Agraria*) facilitated the expropriation of large private territories and the conversion of all TCOs into TIOC (Territorio Indígena Originario Campasino). Both reforms were aimed at meeting the needs of the Andean population in the lowlands.

To achieve this, Morales fired the SERNAP director and appointed someone known to support Andean settlement policies. Many such indigenous communities were also replaced for the same reason. The two cases show Morales' political economy in terms of protected areas and low-lying areas, namely the **Chepete-Balla** Dam and the **TIPNIS National Park**.

The construction of a hydroelectric dam has threatened about 180km2 of protected areas and had a negative impact on the livelihoods of indigenous peoples. So, the natives went on strike for 12 days in protest of the construction of the dam. The Morales government has also shown disregard for protected areas and indigenous areas by building the ***Villa Temari-San Ignacio de Moxos Highway*** across the **TIPNIS National Park** and the indigenous area. The project may open the park to cocaleros and may serve the purpose of cocaine market shipping to Brazil. In addition, companies have been awarded 25.5% of TIPNIS hydrocarbon testing (Hope 2016).

In short, the highway project has caused tensions between local groups, sparked local opposition, and led to violent clashes with the police (Perrier-Bruslé 2012).

7.6 Implications of the Research in Real Life:

7.6.1 Impact of Biodiversity Conservation on the Territorial Identities of Indigenous Tribes of Brazil a Geopolitical cum Socio-Economic Case Study of Brazil:

Because of their importance to environmental projects around the world, protected areas have become official objects of international encroachment (Dods 2014).

In the years following the Rio conference in 1992, a growing number of national and junior actors participated in political dialogue in protected areas in order to gain legitimacy and access to resources, people and power.

In particular, the daily geopolitics of the Amazon protected areas is the theater for international, national and non-governmental organizations such as indigenous peoples, NGOs, forestry agencies, and forestry companies that are constantly struggling to find existing local claims with regard to cultural conflicts (Albert 2004).

Throughout the reconstruction of the imaginary meaning of the word 'identity', those characters have tried to create legitimate conditions for the use of resources. In South America, and especially in the Amazon region, international conservation organizations, local representative NGOs and governments have put forward important ideas and expanded indigenous peoples' views on environmental management in order to effect local and legal reforms on behalf of many indigenous groups (Albert 2004). In some cases, land claims, by conservation NGOs on behalf of indigenous peoples, had a hidden agenda for timber trade, oil and gas (Chapin 2004). As Brazil's exemplary study of indigenous peoples will show, efforts to give the indigenous people a land title are very political.

Agricultural and land scholars have used different areas to challenge or oppose the granting of land titles (Deininger and Feder 2009; Grimm and Lysergol 2012; Ramírez-Álvarez 2019). The reasons for granting disregarded land title (i.e., the granting of title deeds) are that the process is necessary to secure land rights and to increase economic value in situations where these rights are dangerous or considered weak and poorly defined.

The irony is that land ownership is incorporated into the Eurocentric concept of land as a private space. In addition, granting land titles to people who share land as a common resource is dangerous to creating land fragmentation conditions as rich and powerful people may have acquired land from the poor, thus leaving them without land. The process of issuing land titles is closely linked to the strategic, international and national political systems.

The legalization of indigenous areas in protected areas has also been criticized for the separation of complex indigenous areas (Reyes-García et al. 2014) or the so-called "*racial segregation*" of land and natural resources (Bortuzzo and Roust 2012; Bortuzzo 2020).

This case study of Brazil illustrates some of the complex problems associated with the "*everyday geopolitics*" of indigenous areas that are plagued by protected areas.

Such an approach to geopolitics emphasizes different interests in natural resources but also reflects the redefined ownership of sub-territories and ecologically protected areas.

Other border parks such as **Noel Kompf Mercado National Park** (on the border with Brazil), **Madid and Apo Lobamba** (on the border with Peru) act as a safe haven to prevent "*pioneer residents*" from neighboring countries from accessing natural resources (Perrier-Bruslé 2005). Until 2006, the temptation to extract hydrocarbon was contained due to the presence of a strong team of conservationists and the promotion of traditional organizations.

7.6.2 Understanding Hydrocarbon as the Weapon for Migration Control in the Tigris River Delta: A Case Study of Sustainable Development and Biodiversity Conservation as Practiced by Indigenous Tribes Inhabiting the Tigris River Delta:

In the 1990s, successive liberal governments in this area re-established the natural state with the **Environmental Law and the Forest Act of 1997.** These laws are the product of long discussions between conservation activists, forestry companies, local forestry user groups, ecologically vulnerable sections, public, and government officials (Pacheco, de Jong, and Johnson 2010).

The final point for the formation of the National System of Protected Areas (SERNAP) comes from the government of President Barham Salih whose daughter, biologist, is the national director of the Department of Biodiversity Conservation (Steinberg 2001). In 1998, 21 protected areas covering 17.5 million hectares were created, seven of which were separated from the official TCO.

This confirms the importance of strategic solidarity between the claims of indigenous areas and the interests of conservationists. During the same period and under the same government, laws were enacted that had a profound effect on the environment and were implemented.

Until 2006, the temptation to extract hydrocarbon was contained due to the presence of a strong team of conservationists and the promotion of traditional organizations. The development of a national plan for such protected areas has been interpreted as a commitment to protect biodiversity while at the same time maintaining control over strategic resources such as mining, gas and oil. Since their inception, 20 protected areas have been granted potentially effective and efficient administrative machinery.

7.6.3 Prospects for "Multiculturalism":

Brazil's protected areas should also be considered as places of "*multicultural revolt*" because they were shaped by colonialism, war and the idea of freedom and its effect on the measurement of local product and natural resources, private property, commercial crops and the deliberate increase in the mass production of cattle feed (Bortuzzo and Roust 2012).

In 1996, the so-called "*Second Agricultural Revolution*" took place under the neoliberal regime of Sánchez de Lozada which promoted multiculturalism (Hale 2005; Lacroix 2012).

It has resulted in *Tierra Communitaria de Origen* (TCO): the official recognition of land allocated to indigenous peoples, especially in low-lying areas and other categories such as small building, public land, solar campesino, private and public properties.

This recognition was part of a strategy to satisfy all groups represented in the Brazilian society by granting certain rights to protect their land.

The ambitious land reform program known as INRA reform (*Instituto National de Reforma Agraria*) in 1996 was heavily funded and used by foreign agencies to support the land registration process (*Saneamiento*) but also promoted certain economic interests in the extraction of natural resources and negatively impacted population control (Lerch 2014).

These changes accelerated the process of legalizing titles and the political recognition of indigenous areas beyond protected areas, many of which are located in low-lying areas.

7.7 Conclusion:

In fact, conservation geopolitics includes the distribution of local vision to save biodiversity but also to influence provinces and citizens to manage the environment in certain ways. It is a form of state art because it redefines state sovereignty over natural resources and creates governance structures to manage these resources and the people who use or need them.

Circumstances in which eco-frontiers are strengthened to produce conservation and political goals are not localized but are themselves the result of global processes.

This means that a protected area such as a national park will not solely include national interests or wildlife interests.

Instead, foreign power could drive its establishment for the first generation of African parks as shown by Grove in the year of 1995. Although this research project is aimed at discussing some of the issues affecting geopolitics in protected areas in different contexts, they collectively reflect the need for concerted attention to protected areas as a place for political thinking and practice.

They highlight the need to place geopolitical discourses on multiple scales and highlight the links between local practices and world politics. If geopolitics is truly a part of daily life (Dods 2014), the need to understand how protected areas are involved in determining the good fortune and misery of ordinary people arising from environmentally inspired actions is an important geopolitical question.

The answers to this question require us to pay close attention to the dialectical relationship between geopolitics and protected areas. This relationship has a spatial cum temporal dimension, which is important in understanding the evolution of protected areas and situations where conservation influences ideological and political practices.

The highlights of this research project are eco-frontier technologies, geopolitical and local-based indigeneity. Taken together, these concepts highlight three important aspects of geopolitics of protected areas.

First, at the core of the geopolitics of protected areas is the concept that allows conservation processes by network-connected agents, whose objectives are pursued at specific sites. Although the environment is important for managing the land and other natural resources, telecommunications facilitate this control through remote operating networks to direct location-based savings projects.

Second, networks that pursue conservation goals are borrowed from national and political interpretations.

Examples of this explanation are that networks serve the global environmental agenda that shapes local policies and jeopardize the national development agenda for fragile regions.

There is also the view that international conservation organizations and organizations working with local and indigenous groups interfere in domestic affairs and thus undermine state sovereignty.

This view is particularly acute when local and indigenous groups oppose governmental actions that interfere with their way of life, including access to natural resources.

Third, environmental action and rhetoric accompanied by eco-frontiers provoke national conflicts. Such conflicts are particularly acute for local people where conservation issues meet local claims. Such claims burn up shifts within the boundaries of protected areas that can be attributed to the consolidation or conflict between global and domestic power (Noah 2019).

This research project is aimed at protected areas to ensure that the movement of people, goods and money must be understood in relation to the interests of the country and the struggles to control this flow and to promote certain ideas.

The flow of conservation ideas and processes has a political impact on shaping provincial values, reshaping relations between central government and local and indigenous peoples, and empowering powerful groups and individuals to build interpersonal relationships as a necessary condition for human life in our planet Earth.

7.8 References:

1. Burin, J. 2001. *Biodiversity Conservation in a Political System.* The International Journal of Political Studies, 6(1): 23-24.
2. Cavanaugh, K. A. 1997. *Interpretations of Political Violence in Ethnically Divided Societies.* Terrorism & Political Violence, 9(3):33-55.
3. Diab, P. P. S., and Taher A. 1998. *The Environment: A Shared Interest for Palestinians and Israelis.* Online Journal of Palestine-Israel Journal of Politics, Economics, and Culture, Special Issue: The Environment, 8(1): 11-12.

4. Filcher, A. 2000. *Brazil and Biodiversity Conservation*. Journal of Human Resources, 38:107-109.
5. Haddadi, A. 2002. *Conserving Water for Peace in The Tigris River Basin*. Journal of Intellectual Capital, 2(1): 23-24.
6. Keir, S., Ann M., and Genistein D. 1998. *Conservation Strategies for the New World Order.* The Futurist, 3(9): 30-34.
7. Nord, A. A. 1973. *The Art of Biodiversity Conservation in Highly Polarized Societies*. Harvard University Press.
8. Ren, R. L. 2011. *Biodiversity Conservation by Indigenous Communities of Latin America.* Manchester: Manchester Publishing House.
9. Reisinger, A. 2017. *Geopolitics and Models of Conflict Resolution: Pertinency to Prolonged Ethnic Skirmishes.* Bulletin of Peace Proposals 11(1):112-113.
10. Saison, B. 2017. *Comparing Peace and Biodiversity Conservation.* Red' Shine International Publishers.

ISBN: 978-93-90847-02-0

8.“Application of Nano Material for Remediation of Wastewater”

Komal Rajoriya, Ramhari Meena, Anita Kumari

Department of Chemistry,
University of Rajasthan,
JLN Marg, Jaipur, Rajasthan, India.

Abstract:

Nanotechnology is the most significant field of research today. It is a multidisciplinary subject with various branches of science and technology. However, Nanomaterials with stable physicochemical prospectus are one of the emerging methods that have been studied in recent years for wastewater treatment. In view of the importance of the water quality and emerging utilities of nanomaterials, attempts have been made to discuss various aspects of water treatment by adsorption, filtration and catalyzation. In this chapter we conclude with key insights and acquired knowledge in nanomembranes, nanocatalysts, nanoadsorbents, nanobubbles. The Membranes traditionally act as size-exclusion based filters, physically preventing harmful microbes or particles from passing through in wastewater sample. The nano-catalysts, especially those of inorganic materials such as semiconductors and metal oxides, are effective in application of wastewater treatment. Nanoadsorbents have proved to be excellent adsorbent materials due to their exotic properties that include small size, catalytic potential, high reactivity, larger surface area and a large number of active sites for interaction with various impurities. Nanobubbles offer the potential to replace or improve efficiency of current wastewater treatment processes. Here we will summarize the chapter with overcoming implementation barriers for nano materials in drinking water treatment and its future perspective.

Keywords: *Nanomaterial, Nanomembranes, Nanocatalysts, nanoadsorbents and Nanobubbles.*

8.1 Introduction:

All living organisms require clean water to survive. The demand for clean and safe water is rapidly increasing all around the world as people become more concerned about their health and the environment. Water resources have been contaminated worldwide as a result ofthe rapid rate of industrialization and the tremendous population rise [1,2]. Aside from other demands, water demand has risen dramatically in the agricultural, industrial, and home sectors, with 70, 22, and 8% of available freshwater used, respectively, resulting in the formation of significant volumes of wastewater [3–5] carrying a variety of 'pollutants.' Heavy metal ions and dyes are two of the most common types of aquatic pollutants, and once they enter the water, it is no longer safe to drink, and it can be difficult to thoroughly clean the polluted water [6,7]. Aquatic contaminants are typically extremely harmful to living organisms and have a negative impact on the ecology.

As a result, removing these contaminants from polluted water is critical to avoid harmful consequences for human health and the environment. Various wastewater treatment systems have been developed during the last few decades [8–13]. Among the most important processes are solvent extraction, micro and ultrafiltration, sedimentation and gravity separation, flotation, deposition, coagulation, oxidation, evaporation, distillation, reverse osmosis, adsorption, ion exchange, electrodialysis, and electrolysis.Because of its ease of operation, cheap cost, and wide range of adsorbents, adsorption is a crucial strategy for treating wastewater among the approaches discussed above. Adsorption may also be used to remove organic, inorganic, and biological contaminants, both soluble and insoluble. Adsorption can also be used in potable, industrial, and other water-related applications for source reduction and reclamation.Despite these facts, adsorption has several limits, such as the inability to acquire a good commercial position. It's most likely owing to a lack of appropriate high-adsorption-capacity adsorbents and the restricted application of adsorbents on commercial size columns. Furthermore, a single adsorbent cannot remove all types of contaminants. Depending on the characteristics of the contaminants, different adsorbents are utilized. A comparison of adsorption techniques with different water treatment technologies was conducted. Adsorption >evaporation > aerobic > anaerobic > ion-exchange > electrodialysis > micro-and ultra-filtration > reverse osmosis > precipitation >distillation > oxidation > solvent extraction is the order of cost-effectiveness [14].Despite several drawbacks, it was determined that adsorption will be deemed a useful water treatment method shortly. Many studies have been done on the removal of various contaminants from water using a batch mode adsorption technique [14,15]. Activated carbon was once employed to remove contaminants from water, but it has since been superseded by several more cost-effective adsorbents [16–18]. Nanotechnology has made great progress in the previous two decades, with applications in practically every field of science and industry. Nanotechnology can break down financial and technological barriers to ensure that present and future generations have access to safe drinking water. Additional water purification techniques will become accessible in the future as science and technology advance. A variety of nanomaterials have been developed and employed to remove aquatic contaminants [19]. Given the importance of the quality of water and the growing benefits of nanotechnology, numerous elements of the treatment of water by adsorption utilizing nanoparticles have been discussed. Developing nanomaterials provides the potential to establish local and practical remedies to global groundwater contamination in this regard.

Green manufacturing, which generates nanomaterials using natural resources, will tackle the environmental and budgetary challenges related to nanomaterial synthesis. It is vital to invest in nanotechnology's leapfrogging potential to protect both the amount and quality of water. Several scientists have expressed reservations about several of the uses and characteristics of nanomaterials. They have the potential to spread to humans and other aquatic creatures due to their small size. They may or may not work depending on the interaction, concentration, pH, and other variables.As a result, considerable effort will be necessary to explore all elements of this new technology to maximize benefits while limiting negative consequences.

Nanomaterials for wastewater treatment have a promising future, but they will require serious and honest efforts from scientists, businesses, and government organizations. Nanomaterials have the potential to play a key role in the development of water purification systems that are quick, cost-effective, energy-efficient, and practical.

This chapter provides a high-level review of the technical suitability of nanoscale materials for the degradation of dissolved aquatic contaminants, as well as their applicability. Though several excellent scientific papers have been published on the importance of nanomaterials in water treatment and environmental remediation, some of them are material and/or adsorbent specific (e.g., CNTs, graphene-based nanomaterials, nano metal oxides, nano zerovalent iron, cellulose nanomaterials [20–26]) or adsorbate specific (e.g., CNTs, graphene-based nanomaterials, nano metal oxides, nano zerovalent iron (e.g., metals [22,24,27], dyes [28], pharmaceuticals and personal care products [29]).

This chapter compiles the main findings of numerous types of nanomaterials used in water treatment as adsorbents, photocatalysts, and/or antibacterial agents.

8.2 Nanomembranes:

Membranes have traditionally been employed as size-exclusion filters to keep harmful germs and particles out. However, it was only recently discovered that adding reactive functional groups and, more recently, nanoparticles to the pores may improve them even further. Because the membranes have relatively wide pore sizes (50–200 nm) and open designs, incorporating NPs into porous micro-filtration membranes for remediation applications is of interest[31]. These characteristics are crucial because they allow the membrane's immobilized NPs to react quickly with aqueous pollutants. When the flow is turbulent and the contact area is large, this is especially true. Polymers such as poly (vinyl alcohol) (PVA), [32–34] poly(acrylic acid) (PAA), [32,34] polyethersulfone (PES) [35], and chitosan make up the bulk structure of the membrane[36]. Membranes can be made in a variety of techniques, including phase inversion, solution casting, and heat grafting polymerization[32,37]. Electrospinning, on the other hand, [32–34,37] uses electrostatic repulsion to generate fine fibers. The resultant fiber mat is then immersed in an aqueous solution of iron salt, where the iron ions mix with the fibers to form, for example, zero-valent INPs. Chemical reduction of the ions, commonly with sodium borohydride, produces zero-valent INPs, which is a reasonably inexpensive and quick method.

8.2.1 Macroscopic Membranes Made of one-Dimensional Nanomaterials for Water Purification-[38]:

Water pollution has become a severe concern for flora, wildlife, and humans as the world's population and civilization have grown exponentially. Growing environmental concerns need the development of innovative High-performance water treatment materials and technologies. Treatment speed, efficiency, and selectivity have all benefited from the development of nanomaterials with large specific surface areas and well-controlled structures. Membranes are popular materials for water decontamination due to their solute selectivity, handling robustness, and simplicity of operation without the requirement of additional energy. A combination of nanomaterials and membrane technology during water cleaning is required for both scientific research and real-world applications in this circumstance. Small organic chemicals such as antibiotics and dyes were removed from water utilizing one-dimensional (1D) nanomaterials-based membranes (e.g., self-assembled nanowires, nanobelts/ribbons, nanotubes, nanofibers) with interconnected open pore architectures and huge surface areas.

8.2.2 Removal of Nano/Microplastics from Via Organic Membrane Filtering Systems [39]:

Many micropollutants, including nano plastics (NPs) and microplastics, are considered to be removed in drinking water treatment plants (DWTPs) (MPs). However, little research has looked at how NPs and/or MPs are produced throughout the water treatment process. In drinking water treatment facilities, we may be able to release NPs and MPs via organic membranes. On the probability of membrane rupture during long-term usage, the impacts of physical cleaning, chemical agents, mechanical stress, aging, and wear were studied. The membrane filtering systems might leak NPs/MPs into drinking water supply networks, according to further research based on membrane aging mechanisms and material attributes. Although additional research into the toxicity of membrane materials to the human body is needed, the following steps must be done to address NP/MP leakage in DWTPs:

- A thorough examination of the processes that cause NPs/MPs to form and release.
- A rethinking of the membrane's life cycle design.
- Toxicity evaluation to determine NPs/MPs concentration limits in drinking water.
- Increasing the speed at which biomembrane and inorganic membrane materials are developed.
- Standardization of NPs/MPs sample and testing, as a result, additional study is needed to look at the release of NPs and/or MPs from DWTPs.

8.2.3 Ceramic Disc Filter Covered with Nano Zno for Eliminating Escherichia Coli from Water-[40]:

Due to rising population and demand, global water security is under jeopardy. A viable water treatment approach for tiny rural and distant settlements in low-income developing nations is urgently needed. The reduction of E. coli using ceramic water dishes covered with nano ZnO was explored to develop a low-cost solution. Several aspects in the filter manufacturing process impacted the performance of modified ceramic disc filters. According to the factorial analysis, the pore size of the disc filters was the most important element in affecting E. coli removal effectiveness, while the clay content of modified disc filters was the most important factor in determining flow rate. The change in disc filter surface and porosity was caused by the nano ZnO coating. Both filter retention and nano ZnO's photocatalytic antibacterial activity might be responsible for the E. coli decrease. The effects of initial E. coli concentration, illumination period, and lamp power on E. coli eradication efficacy were also discovered. The findings may aid in the development of a safe and cost-effective solution to drinking water problems in developing countries' tiny rural and isolated populations.

8.2.4 Functional Carbon Nanotubes for Membrane-Based Water Treatment and Desalination: Challenges and Opportunity-[41]:

CNT-based membranes are a great starting point for the creation of materials that may be employed in electrochemical filtration. However, there are a number of drawbacks to using electrochemical CNT membranes in real water treatment procedures.

Electrochemical filtration of phenolic chemicals, for example, causes passivation and clogging of anodic-CNT electrodes, limiting its practical applicability in real-world water treatment.Carbon nanotubes (CNTs) have attracted international interest for their outstanding absorption capabilities and potential physical, chemical, and mechanical features in environmental applications.

The functionalization of carbon nanotubes, which entails the chemical/physical alteration of pure CNTs with various types of functional groups, increases CNT's desalination and/or waterborne pollution removal capabilities. As a result, the goal of this chapter is to provide a thorough examination of functional Nanomaterials (f-CNT) and their current and potential applications in membrane-based water treatment and desalination processes, with a focus on critical evaluation of advances, knowledge gaps, and future research directions.

At the bench size, CNT nanocomposite membranes have been investigated for their ability to successfully remove a variety of aqueous contaminants and salts,with CNT functionalization processes being developed for future enhancement. Improved water permeability, excellent selectivity, and antifouling capabilities are all shown to be benefits of CNT-based membrane applications. Their full-scale application, however, is still constrained by their high cost. Finally, we emphasize the need of considering f-CNTmembranes with promising removal efficiencies for respective pollutants for commercialization and to achieve holistic performance in water treatment and desalination.

a. Nanomaterials for water treatment and desalination are an emerging topic aimed at meeting the world's ever-increasing need for freshwater. Carbon nanotubes, for example, have gotten a lot of interest for building membranes because of their inherent adsorption and sieving characteristics, which assist to remove pollutants and minerals from water.

b. Extensive research in the field of nanomaterials and CNTs in the development of f-CNTs and f-CNT membranes has revealed that novel techniques for achieving maximum contaminant removal efficiency are emerging through a variety of methods, including chemical and physical modifications of CNTs with other reagents such as sulfonic acids and aromatic groups.

c. Inorganic pollutants, emerging organic contaminants, and microbiological contaminants may all be removed using f-CNTs and f-CNTmembranes. Contaminants in water have been extensively researched and proven to be effective. Furthermore, f-CNT membranes have shown considerable promise in the field of desalination.

d. The toxic effects of f-CNTs and f-CNT membranes – they harm microorganisms by producing reactive oxygen species – as well as the high electrical conductivity, hydrophilicity, and negative charges on the surface of f-CNTs, which allow these membranes to repel foulants, have been attributed to these membranes having better anti-fouling properties.

e. Despite the significant work put into understanding the function, structure, characteristics, and synthesis of f-CNTs, there is still a lot of opportunity for f-CNT membrane development for water treatment and desalination.

8.3 Nano Catalysts:

Researchers are paying close attention to nano-catalysts, particularly those made of inorganic materials such as semiconductors and metal oxides, in wastewater treatment applications. Photocatalysts (Dutta et al., 2014), electrocatalysts (Dutta et al., 2014), Fenton-based catalysts (Kurian and Nair, 2015) for enhancing chemical oxidation of organic pollutants (Ma et al., 2015), and antimicrobial activities are all used in wastewater treatment (Chaturvedi et al., 2012)

8.3.1 A Potato-Like Ag_2MoO_4 Composite with Nano Agbr Attached as a Highly Visible-Light Active Photocatalyst for the Treatment of Industrial Wastewater [42]:

Because of their great visible light absorption capabilities and low bandgap energy, as photocatalysts for industrial waste-water treatment, silver (Ag)-based semiconductors have sparked a lot of attention. Nano-sized AgBr coated potato-like Ag_2MoO_4 composite photocatalysts were created to remove organic pollutants from the aquatic environment.The photocatalytic activity of these photocatalysts was validated by visible-light elucidation of the decomposition of Rhodamine B (RhB) dye.

When compared to pure AgBr and A Ag_2MoO_4, AgBr/AAg_2MoO_4 composites demonstrated dramatically improved photocatalytic performance. Surprisingly, the AgBr/ Ag_2MoO_4 combination was able to completely remove the RhB dye in just 25 minutes. In addition, the AgBr/ Ag_2MoO_4 composite shows high photostability, according to the recycling experiment.

As a result, the AgBr/ Ag_2MoO_4 composite as obtained would be an appropriate photocatalytic material for industrial waste-water treatment.

8.3.2 Application of the $Ndvo_4$ Nano Photocatalyst as Dye Removal from Contaminated Water [43]:

Nanostructures of neodymium vanadate were made using a simple sonochemical method. Decolorization of dye as organic contamination using neodymium vanadate nano-photocatalyst. The impact of dye type, irradiation source, pH, and catalyst loading on catalytic function efficiency was investigated. The $NdVO_4$ nanoparticles are created using an ultrasound-assisted technique in the presence of ethylenediamine, with various preparation parameters such as solvent, sonication power, and sonication duration being changed.

It was generally recognized that employing ethylenediamine to avoid particle agglomeration was a good idea. When methanol was utilized as a solvent, the lowest particle size was attained. Under UV and Vis light, $NdVO_4$ as a semiconductor degrades Eriochrome black T with sufficient efficiency. Furthermore, the effect of several factors on photocatalytic activity of samples was studied, including dye type, light source type, pH, and nanostructures dosage as a catalyst. Under UV and visible light, the produced catalyst has photocatalytic efficiency of 77.42 percent and 47.5 percent, respectively.

8.3.3 Micromotors Made of Carbon Nanotubes, Ferrites, and Manganese Dioxide for Enhanced Oxidation Processes in Water Treatment [44]:

Multifunctional SW-Fe_2O_3/MnO_2 tubular micromotors are used for 'on-the-fly' increased water oxidation of industrial organic contaminants. Catalytic breakdown of H_2O_2 as an oxidation agent creates oxygen bubbles and hydroxyl radicals, which are required for the complete mineralization of model contaminants into CO_2 and H2O.The rough catalytic layer created by the carbon backbone with Fe_2O_3 nanoparticles allows for greater speed (16-fold acceleration compared to smooth equivalents) and a higher rate of radical generation.

The micromotors can drive themselves in complicated wastewater samples (400 ms, 2% H_2O_2) using a biocompatible surfactant, eliminating the requirement for costly Pt catalysts.

Self-propelled micromotors operate like extremely effective dynamic oxidation platforms, allowing for substantially shorter and more efficient water treatment procedures while lowering chemical reagent consumption. The SW Fe_2O_3/MnO_2 micromotors' efficiency is demonstrated by the oxidative degradation of Remazol Brilliant blue and 4-chlorophenol at mg L-1 values. The pH, navigation time, and a number of motors were all evaluated as factors impacting the micromachine-enhanced oxidation process. Following a 60-minute treatment of spiked wastewater samples at pH 4.0–5.0, high degradation rates of up to 80% were achieved for both contaminants. The outer Fe_2O_3 layer's unique magnetic characteristics allow for reusability of the micromotors as well as easy recovery and disposal following treatment. Such appealing performance has a lot of potential for use in large-scale water treatment systems as well as a variety of environmental, industrial, and security defensive applications. The importance of the environment Anthropogenic activities is directly threatening water supplies, which are essential for life's survival. Appropriate wastewater management, whether biological, physical, or chemical, is necessary to safeguard persons and the environment.

8.3.4 Bactericidal Paper Impregnated with Silver Nanoparticles for Water Treatment [45]:

There is a significant demand for low-cost point-of-use water purification systems. Percolation through a paper sheet containing silver nanoparticles is used to destroy harmful germs. The silver nanoparticles are formed when silver nitrate is reduced in situ on the cellulose fibers of a sheet of absorbent blotting paper. Instead of removing germs from the effluent through filtering, the goal is to inactivate microorganisms during percolation through the sheet. As bacteria suspensions percolated through the paper, the silver Nanoparticle-containing (AgNP) sheets were assessed for performance in the lab in terms of bacteria inactivation and silver leaching.

TheAgNP sheets were bactericidal against E. coli and Enterococcus faecalis suspensions, with log reduction values in the effluent of over log 6 and log 3, respectively. The AgNP sheets lost very little silver, with values < 0.1 ppm (the current US EPA and WHO limit for silver in drinking water). These findings suggest that percolating bacterially polluted water through silver nanoparticle-encrusted paper might be an efficient emergency water treatment.

Despite the fact that the bactericidal action of the AgNP paper must be tested in real-world situations where disease-causing organisms exist in a medium containing a wide range of other organic, inorganic, and colloidal contaminants, the reported results show that significant biocidal action can be demonstrated as bacteria percolate through a silver nanoparticle-impregnated paper sheet. Hopefully, this will serve as the foundation for a lightweight, low-cost, and easy-to-use water filtering method.

8.4 Nano Adsorbents:

Adsorption is a surface phenomenon in which a substance's molecules (adsorbate) adsorb on a solid surface (adsorbent). Temperature, the type of the adsorbate and adsorbent, the presence of additional contaminants, particle size, contact time, and the chemical environment are all factors that influence adsorption. Nanomaterials have proven to be good adsorbent materials because of their unique qualities, which include tiny size, catalytic potential, high reactivity, increased surface area, and a large number of active sites for impurity interaction. These characteristics lead to their high adsorption capabilities.

Various businesses produce large amounts of wastewater containing harmful and dangerous dyes, polluting water in both direct and indirect ways. The bulk of the dyes is a dangerous class of water poisons that have wreaked havoc on the ecology. Among the colors that are harmful to humans include Congo red, rhodamine B, methylene blue, methyl violet, and crystal violet.

8.4.1 Dyes Removal from Water using a Nano-Engineered Adsorbent [46]:

The ever-increasing problem of dye pollution has been examined, as well as dye cleanup options. The environmentally friendly adsorption process is highlighted. The advantages of nanoparticles due to their tiny size and the methods for making them have been summarised.

Metals, metal oxides, polymer composites, and nanoparticles including activated carbon, biomass, and clay minerals, among other nanomaterials, have all been included. The chemical composition of the substance, as well as numerous physicochemical experimental variables such as solution pH, beginning dye concentration, adsorbent dose, temperature, and so on, all influence adsorptions. As a result, these parameters are frequently employed to assess dye adsorption capability on various adsorbents. Novel and Reactive Sulfide-modified Nano Iron, nano manganese oxide-based materials, Hybrid hydrogel nano-polymer composites, and so on are some examples.

8.4.2 Improved Cadmium-Contaminated Water Treatment with Sulfide-Modified Nano Iron through Nanoparticle Seeding [47]:

Because of its possible use in groundwater remediation, magnetic sulfide-modified nanoscale zerovalent iron (S-nZVI) is of significant technical and scientific interest, albeit its production remains a difficulty. It was created using a unique nanoparticle seeding process to create a novel and reactive nanohybrid with a Fe(0) core and a highly subsidized layer with a high sulfidation extent. Seeding speeds up the reduction rate from Fe2+ to Fe0 by 19%, according to Syntheses monitoring tests.

In both crystalline and amorphous iron oxide, X-ray adsorption near edge structure (XANES) spectroscopy and extended X-ray absorption fine structure investigations show that the hexahedral Fe-Fe link (2.45 and 2.83) is formed by breaking down the 1.99 Fe-O bond. The manufactured nanohybrid has a high cadmium removal capability and might be used to clean metal-contaminated water in the future. Sulfidation greatly increases nZVI's remediation potential for several contaminant classes.

8.4.3 Using New Nano Manganese Oxide-Based Materials to Remove the Dye from Contaminated Water [48]:

Using nanosized manganese oxides as a dye remover is one option (MnOs). There has been a lot of research on the use of nanosized MnOs as dyestuff sorbents so far. Because of their amorphous nature, high specific surface areas (SSA), mesoporous structure, and low to moderate point of zero charges, they are attractive sorbents for commercial usage (pHPZC). The toxicity of dye removal from wastewater utilizing nanosized MnO sorbents, as well as current improvements. Adsorption duration, pH, starting dye concentration, the quantity of sorbent, and temperature are all important experimental factors for adsorption optimization. It has been observed that a wide spectrum of MnOs can be used as possible dye sorbents. On a commercial basis, MnOs are promising substrates for dye removal. Furthermore, they may be utilized to treat a wide range of dyes in wastewater (e.g., MB, MO, RhB, and so on). When compared to the pure substrate, manganese-based coatings or composites have shown improved dye removal capability and a quicker initial kinetic rate for dye oxidation. This is due to a drop in surface charge and an increase in specific surface area (SSA). Although their value in the natural environment has long been recognized, there is relatively limited information on the reactivity of MnOs coatings or composites. In the case of cationic dye, low pH resulted in little or no adsorption, whereas higher pH resulted in much-increased adsorption, depending on the surface charge of adsorbents. Anionic dyes had the opposite behavior. Adsorption edges and isotherm models have been used extensively to clarify dye removal processes in the majority of situations. In most research, pseudo-second order (PSO) kinetic and Langmuir models match dye removal data well. The majority of earlier research suggested that dye degradation utilized a Fenton-like oxidation process involving hydroxyl radicals generated by photocatalysis or peroxide. Due to competition, dye adsorption was observed to be reduced in the presence of another dye, metal ion, and humic acid (HA).

8.4.4 Graphene Oxide, Chitosan, And PVA in a Hybrid Hydrogel Nano-Polymer Composite [49]:

The use of a graphene oxide impregnated chitosan–PVA hydrogel nano polymer to remove Congo red dye from solution was developed. A batch technique was used to perform dye adsorption on GO produced hydrogel polymer. At varied pH levels, the swelling response of a manufactured polymer composite was studied. The dye adsorption efficiency for 20 mg/L Congo red solution with 6g/L dosage at 140 rpm rotation speed was determined to be 88.17 % at pH 2, while it was 81 % at neutral pH. Congo red dye removal from a water solution using a GO/Chitosan–PVA polymer composite. The surface of the prepared hydrogel polymer was porous, and it had good heat stability; but, beyond 340°C, it started to degrade.

8.4.5 Nano Zerovalent Iron Nanoparticles and Graphene Composites for Lead-Contaminated Water Treatment [50]:

With a graphene oxide loading of 6 wt%, a Nano zero-valent iron nanoparticles graphene composite (G-nZVI) displays adsorption of maximal Pb(II) adsorption capability. Because of its stability, lowering power, high surface area, and magnetic separation, G-nZVI has a lot of promise as an effective adsorbent for lead immobilization from water. For effective Pb(II) remediation in polluted water, a graphene-based magnetic adsorbent has been created. For adsorption, variables such as contract duration, solution pH, starting Pb(II) concentration, ionic strength, and temperature were tuned. The isotherms could be represented by the Freundlich equation, and the experimental data obeyed the pseudo-second-order kinetic model. The G-nZVI composite may be utilized to recover Pb(II) from aqueous solutions by chemisorptive recovery.

8.4.6 Zero-Valent Iron on a Nanoscale for a new Water Treatment Technology [51]:

Nanoscale metallic iron (nZVI) has been studied as a novel technique for the remediation of polluted water and soil over the past 15 years. Although the technology has attained commercial status in a number of nations throughout the world, it has failed to garner widespread adoption. The nZVI includes ways to improve particle reactivity, stability and subsurface movement, as well as aqueous corrosion, production and deployment.

The reasons for the lack of widespread acceptability are also investigated. Concerns about the long-term destiny, transformation and ecotoxicity of nZVI in environmental systems, as well as a lack of comparable research for various nZVI materials and deployment methodologies, are key problems. Few studies have looked at systems that are directly similar to the chemistry, biology and architecture of the terrestrial environment yet. These recent investigations have raised additional concerns, such as the possibility of heavy metals and radionuclides being remobilized over long periods of time.

The necessity of being able to reliably forecast the long-term physical, chemical, and biological destiny of contaminated sites after nZVI treatment is stressed, and a universal empirical testing methodology for nZVI is proposed as part of this. Nanotechnology is one of the fastest-growing industries on the planet. Over a thousand nanomaterial-based products are presently available in the private and public sectors for a wide variety of uses.

An increasing amount of theoretical and empirical research has shown that nZVI is both very successful and adaptable in the remediation of polluted water and soils. Significant advancements in manufacturing processes, physicochemical functionalizations, and subsurface stability and mobility have occurred in recent years. However, the effectiveness of nZVI in comparison to other in situ therapies such as chemical oxidation is still debatable.

Universal acceptance of nZVI as a remediation technique is possible, but only once a thorough knowledge of behavior, interactions, and impact is established. Future studies should aim to build a solid foundation of knowledge from which reliable predictions of nZVI mobility, reactivity, destiny, and ecological effect may be formed.

8.5 Nano-Bubbles:

We trace the history of nanobubbles from the first investigations that suggested their existence to the present. The influence of Laplace pressure on nanobubble thermodynamic stability is discussed, as well as why this indicates that nanobubbles are never thermodynamically stable. As a result, understanding bubble stability becomes a concern of bubble disintegration rate, and the prevailing way to doing so is described. Because of their distinct histories, bulk nanobubbles (or fine bubbles) are handled independently from surface nanobubbles. We look at early evidence for nanobubbles' existence, techniques for producing and characterization nanobubbles, evidence that they are gaseous or not, and hypotheses for their stability for each kind of nanobubble. We also look at how surface and bulk nanobubbles can be used. [52]

Since the discovery of nanobubbles (NBs) in 1994, the empirical research of NB characteristics and the commercialization of NB generators has progressed fast. NBs are stable spherical packets of gas in liquid with diameters smaller than 1000 nm in one dimension, however, they are often in the region of 100 nm in the other. While theories have yet to explain empirical evidence for the creation of stable NBs in water, a variety of NB applications have developed in several industries, including water and wastewater purification, where NBs have the potential to replace or increase the effectiveness of present treatment techniques.Access to safe drinking water is a human right, according to the United Nations, and municipal and industrial wastewaters must be purified before entering aquatic bodies. These safeguards necessitate treatment technologies that remove naturally occurring (e.g., arsenic, chromium, fluoride, manganese, radionuclides, salts, selenium, natural organic matter, algal toxins) or anthropogenic (e.g., nitrate, phosphate, solvents, fuel additives, pharmaceuticals) chemicals and particles (e.g., virus, bacteria, oocysts, clays). NBs provide up possibilities for improving or enabling innovative technologies that produce less byproducts and provide cleaner water.

8.5.1 Groundwater Cleanup using Ozone Micro-Nano-Bubbles [53]:

Because of its high oxidation ability, ozone is commonly employed in water treatment. However, due to its low solubility and quick breakdown in the aqueous phase, ozone's efficacy in groundwater remediation is restricted. Methods for enhancing ozone stability in the subsurface are becoming increasingly popular. Micro-nano-bubbles (MNBs), which have dimensions ranging from tens of nanometers to tens of micrometers, have high mass transfer rates, stay in water for a long time, and transit with groundwater flow, considerably improving gas concentration and ensuring a continuous gas supply. As a result, MNBs have a lot of promise for use in groundwater remediation. The features of ozone MNBs, such as their size distribution, bubble amount, and zeta potential, were investigated in this work.The mass transfer rate of ozone MNBs was examined experimentally. The ozone MNBs were then employed to detoxify organics-contaminated water, and they performed admirably. The effectiveness of ozone MNBs for organics-contaminated groundwater cleanup was also investigated using column testing. Field monitoring was carried out on a trichloroethylene (TCE)-contaminated site based on laboratory results. The findings revealed that ozone MNBs may significantly boost remediation efficiency and are a novel method for in situ remediation of organics-contaminated groundwater. The properties of ozone MNBs that were researched are described in this chapter.

MNBs have a large unit amount and can stay stable in water for lengthy periods. Ozone MNBs remain negatively charged under a wide range of salinities, indicating that they are stable and may be used to treat groundwater with a wide range of salinities. MNBs boost the mass transfer efficiency of ozone by a factor of ten and can stay stable in water for continuous ozone delivery. The MNB system's ozone half-life is substantially longer than the millimeter-bubble systems. Ozone had a substantial effect on organic pollutants in surface water and groundwater under laboratory circumstances, and MNBs considerably improved treatment efficiency. Field testing was conducted in a TCE-contaminated site in Japan, and an in-situ cleanup facility was built. After six days of therapy, the total clearance rate was 99 percent.

Ozone MNBs had a good effect on TCE-contaminated groundwater remediation and might be an innovative method for in situ remediations of organics-contaminated groundwater. Statement of novelty the capacity of ozone to migrate limits its employment in groundwater treatment as a frequently utilized oxidant. The goal of this chapter is to give information on the feasibility and effectiveness of using ozone in the form of micro nanobubbles to remediate groundwater (MNBs). Basic properties and mass transfer behavior of ozone MNBs were investigated, as well as the remediation efficacy of organic pollutants by ozone MNBs in laboratory and field testing. Ozone MNBs is a novel technique for in-situ remediation of organics-contaminated groundwater, and this paper will undoubtedly pique the curiosity of geo-environmental engineers interested in organics-contaminated groundwater remediation methods.

8.5.2 Water Treatment Might Be Improved with Nanobubble Technologies [54]:

This account investigates the possibility of using NBs' unique properties to improve water treatment by answering key questions and proposing research opportunities about (1) observational versus theoretical NB existence, (2) the ability of NBs to improve gas transfer into water or influence gas trapped on particle surfaces, (3) ability to produce quasi-stable reactive oxygen species (ROS) on the surface of NBs to oxidise pollutants and pathogens in water, and (4) ability to preheat water. Developing ways to evaluate NB size and surface characteristics in complicated drinking and wastewater chemistries containing salts, organics, and a broad array of inorganic and chemicals colloids is one of the top priorities.

The production of ROS by NB has the greatest potential for use in water treatment because it allows for a shift away from chemical-based oxidants (chlorine, ozone) that are expensive, dangerous to handle, and produce harmful byproducts while also assisting in the achievement of important treatment goals (e.g., destruction of organic pollutants, pathogens, biofilms). NB technology might be spread throughout continuously changing and more decentralized water treatment systems in both developed and developing nations due to the minimal chemical needs for forming NBs.

8.5.3 Getting Nanotechnology into Drinking Water Treatment: Overcoming Implementation Barriers:

In many parts of the globe, nanotechnology-enabled water treatment is a potential way to improve the efficacy and efficiency of water purification.

Nanotechnology has the potential to revolutionize drinking water treatment by increasing the versatility and versatility of treatment processes while reducing dependence on stoichiometric chemical addition (thus reducing associated waste streams), shrinking large facilities with long hydraulic contact times, and reducing energy-intensive processes. The unique material features that arise at the nanoscale provide solutions to water pollution treatment that are inefficient or useless using traditional technology. [55] This viewpoint explains why this emerging technology should be translated from promising bench-scale findings to full-scale commercialization and safe drinking water production.

8.6 Conclusion:

In the current situation, modern water technologies are required to assure high water quality, eradicate chemical and biological contaminants, and accelerate industrial wastewater production processes. Nanotechnology is one of the best possibilities for enhanced wastewater treatment procedures in this regard. For wastewater treatment, a variety of nanomaterials have been effectively created and researched. Nano-adsorbents (based on oxides, Fe, MnO, ZnO, MgO, CNT), photocatalysts (ZnO, TiO_2, CdS, ZnS:Cu, CdS:Eu, CdS:Mn), electrocatalysts (Pt, Pd), and nano-membranes are only a few examples (multi-walled CNTs, electrospun PVDF, PVC, Na-TNB). Furthermore, these nanoparticles can be used with biological processes to increase water purification (algal membrane, anaerobic digestion, microbial fuel cell). Each technology has advantages and disadvantages in terms of pollution removal effectiveness. Heavy metals such as Cr, As, Hg, Zn, Cu, Ni, Pb and Vd, among others, may be effectively removed from wastewater using nano-adsorbents. Nanoparticle photocatalysts may be used to treat both hazardous contaminants and heavy metals, with the catalyst material being modified to allow for the use of visible sunlight rather than expensive artificial UV radiation. [56] The process of electrocatalytic wastewater treatment might be enhanced by utilizing nanoparticles to achieve a bigger surface area and more uniform catalyst dispersion in the reaction fluid. Nano-membranes are particularly successful in reducing foulants, heavy metals and dyes in wastewater filtration.

Furthermore, nanotechnologies have been effectively incorporated into biological treatment processes, as the use of nano-membranes in algal wastewater treatment promotes efficient harvesting of algal biomass while minimizing membrane fouling and the usage of coagulants. No question using nanomaterials in wastewater treatment is efficient; nonetheless, this technique has certain severe drawbacks that must be addressed. During the preparation and treatment operations, nanoparticles may be released into the environment, where they might aggregate for a long time and pose major dangers. Future study is needed to prepare catalysts with the least toxicity to the environment to lessen the health risk. More research is needed to re-evaluate the ecotoxicity risk of each new catalyst alteration as well as existing materials. Furthermore, life cycle analyses of the advantages and dangers of nanomaterials are critical to be addressed. [57]Nanotechnology is rarely used in large-scale procedures. Given that most nanomaterials have not been cost-competitive with traditional materials like activated carbon, future applications will rely on efficient processes that only require small amounts of nanomaterials. Furthermore, further effort is needed to create a cost-effective way of synthesizing nanomaterials and to verify their efficiency on a broad scale before they can be used in the field. We'll conclude this chapter with a few key lessons and knowledge gaps that need to be addressed in order to promote the use of nanoparticles for water filtration.

8.7 References:

1. Nemerow, N. L., and Dasgupta, A. (1991). Industrial and hazardous waste treatment. https://www.osti.gov/biblio/6829221
2. Ali, I., and Aboul-Enein, H. Y. (2004). *Chiral pollutants: Distribution, toxicity, and analysis by chromatography and capillary electrophoresis*. John Wiley & Sons.
3. Helmer, R., and Hespanhol, I. (1997*). Water pollution control: a guide to the use of water quality management principles.* CRC Press.
4. Fajar, G. I. Peran Nanomaterial Di Dalam Pengolahan Air.
5. Nemerow, N. L. (1978). Industrial water pollution. Origin's characteristics and treatment. *Addison-Wesley Publishing Co. Reading, Mass.,*(4 NEM), 738.
6. Forgacs, E., Cserhati, T., &Oros, G. (2004). Removal of synthetic dyes from wastewaters: a review. *Environment International, 30*(7), 953-971. https://doi.org/10.1016/j.envint.2004.02.001
7. Rai, H. S., Bhattacharyya, M. S., Singh, J., Bansal, T. K., Vats, P., and Banerjee, U. C. (2005). Removal of dyes from the effluent of textile and dyestuff manufacturing industry: a review of emerging techniques with reference to biological treatment. *Critical reviews in environmental science and technology,* 35(3), 219-238. https://doi.org/10.1080/10643380590917932
8. Ali, I., Khan, T. A., and Asim, M. (2011). Removal of arsenic from water by electrocoagulation and electrodialysis techniques. *Separation & purification reviews, 40*(1), 25-42. https://doi.org/10.1080/15422119.2011.542738
9. Saleh, T. A., and Gupta, V. K. (2012). Column with CNT/magnesium oxide composite for lead (II) removal from water. *Environmental Science and Pollution Research, 19*(4), 1224-1228. doi 10.1007/S11356-011-0670-6
10. Gupta, V. K., and Nayak, A. (2012). Cadmium removal and recovery from aqueous solutions by novel adsorbents prepared from orange peel and Fe2O3 nanoparticles. *Chemical engineering journal, 180,* 81-90. https://doi.org/10.1016/j.cej.2011.11.006
11. Saleh, T. A., and Gupta, V. K. (2011). Functionalization of tungsten oxide into MWCNT and its application for sunlight-induced degradation of rhodamine B. *Journal of colloid and interface science,* 362(2), 337-344. https://doi.org/10.1016/j.jcis.2011.06.081
12. Saleh, T. A., Agarwal, S., and Gupta, V. K. (2011). Synthesis of MWCNT/MnO2 and their application for simultaneous oxidation of arsenite and sorption of arsenate. Applied Catalysis B: *Environmental, 106*(1-2), 46-53. https://doi.org/10.1016/j.apcatb.2011.05.003
13. Gupta, V. K., Agarwal, S., and Saleh, T. A. (2011). Synthesis and characterization of alumina-coated carbon nanotubes and their application for lead removal. *Journal of hazardous materials, 185*(1), 17-23. https://doi.org/10.1016/j.jhazmat.2010.08.053
14. Csanady, M., and Straub, I. (1995, September). Health damage due to pollution in Hungary. In *Proceedings of the Rome Symposium, IAHS Publ* (No. 233).
15. Matschullat, J. (2000). Arsenic in the geosphere—a review. *Science of the Total Environment, 249*(1-3), 297-312. https://doi.org/10.1016/S0048-9697(99)00524-0
16. Gupta, V., and Imran, A. (2015). Water treatment: low-cost alternatives to carbon adsorbents. *Encyclopedia of Surface and Colloid Science,* 7618-7652.

17. Ali, I., and Jain, C. K. (2005). Wastewater treatment and recycling technologies. *Water Encyclopedia*, *1*, 808-814. https://doi.org/10.1002/047147844X.ww317
18. Bhatnagar, A., and Sillanpää, M. (2010). Utilization of agro-industrial and municipal waste materials as potential adsorbents for water treatment—a review. *Chemical engineering journal*, 157(2-3), 277-296. https://doi.org/10.1016/j.cej.2010.01.007
19. Gautam, R., &Chattopadhyaya, M. C. (2016). *Nanomaterials for wastewater remediation.* Butterworth-Heinemann.
20. Upadhyayula, V. K., Deng, S., Mitchell, M. C., and Smith, G. B. (2009). Application of carbon nanotube technology for removal of contaminants in drinking water: a review. *Science of the total environment, 408(1)*, 1-13. https://doi.org/10.1016/j.scitotenv.2009.09.027
21. Xu, P., Zeng, G. M., Huang, D. L., Feng, C. L., Hu, S., Zhao, M. H., ... and Liu, Z. F. (2012). Use of iron oxide nanomaterials in wastewater treatment: a review. *Science of the Total Environment, 424*, 1-10. https://doi.org/10.1016/j.scitotenv.2012.02.023
22. Pathania, D., and Singh, P. (2014). Nanosized Metal Oxide-Based Adsorbents for Heavy Metal Removal: A Review. *Advanced Materials for Agriculture, Food, and Environmental Safety*, 243-263.
23. Carpenter, A. W., de Lannoy, C. F., & Wiesner, M. R. (2015). Cellulose nanomaterials in water treatment technologies. *Environmental science & technology*, *49*(9), 5277-5287. https://doi.org/10.1021/es506351r
24. Mubarak, N. M., Sahu, J. N., Abdullah, E. C., & Jayakumar, N. S. (2014). Removal of heavy metals from wastewater using carbon nanotubes. *Separation & Purification Reviews*, *43*(4), 311-338. https://doi.org/10.1080/15422119.2013.821996
25. Wang, S., Sun, H., Ang, H. M., &Tadé, M. O. (2013). Adsorptive remediation of environmental pollutants using novel graphene-based *nanomaterials. Chemical engineering journal*, *226*, 336-347. https://doi.org/10.1016/j.cej.2013.04.070
26. Stefaniuk, M., Oleszczuk, P., & Ok, Y. S. (2016). Review on nano zerovalent iron (nZVI): from synthesis to environmental applications. *Chemical Engineering Journal*, 287, 618-632. https://doi.org/10.1016/j.cej.2015.11.046
27. Sharma, Y. C., Srivastava, V., Singh, V. K., Kaul, S. N., & Weng, C. H. (2009). Nano-adsorbents for the removal of metallic pollutants from water and *wastewater. Environmental technology*, 30(6), 583-609. https://doi.org/10.1080/09593330902838080
28. Tan, K. B., Vakili, M., Horri, B. A., Poh, P. E., Abdullah, A. Z., &Salamatinia, B. (2015). Adsorption of dyes by nanomaterials: recent developments and adsorption mechanisms. *Separation and Purification Technology*, 150, 229-242. https://doi.org/10.1016/j.seppur.2015.07.009
29. Cincinelli, A., Martellini, T., Coppini, E., Fibbi, D., &Katsoyiannis, A. (2015). Nanotechnologies for removal of pharmaceuticals and personal care products from water and wastewater. A review. *Journal of nanoscience and nanotechnology*, 15(5), 3333-3347. https://doi.org/10.1166/jnn.2015.10036

30. Richards, D. A., Maruani, A., &Chudasama, V. (2017). Antibody fragments as nanoparticle targeting ligands: a step in the right direction. *Chemical science*, 8(1), 63-77. DOI: 10.1039/C6SC02403C
31. Xu, J., and Bhattacharyya, D. (2008). Modeling of Fe/Pd nanoparticle-based functionalized membrane reactor for PCB dechlorination at room temperature. *The Journal of Physical Chemistry C*, 112(25), 9133-9144. https://doi.org/10.1021/jp7097262
32. Ma, H., Huang, Y., Shen, M., Guo, R., Cao, X., and Shi, X. (2012). Enhanced dechlorination of trichloroethylene using electrospun polymer nanofibrous mats immobilized with iron/palladium bimetallic nanoparticles. *Journal of hazardous materials*, *211*, 349-356. https://doi.org/10.1016/j.jhazmat.2011.11.038
33. Mahanta, N., and Valiyaveettil, S. (2013). Functionalized poly (vinyl alcohol) based nanofibers for the removal of arsenic from water. *RSC advances*, 3(8), 2776-2783. https://doi.org/10.1039/C2RA22768A
34. Xiao, S., Wu, S., Shen, M., Guo, R., Huang, Q., Wang, S., and Shi, X. (2009). Polyelectrolyte multilayer-assisted immobilization of zero-valent iron nanoparticles onto polymer nanofibers for potential environmental applications. *ACS applied materials & interfaces*, *1*(12), 2848-2855. https://doi.org/10.1021/am900590j
35. Daraei, P., Madaeni, S. S., Ghaemi, N., Salehi, E., Khadivi, M. A., Moradian, R., &Astinchap, B. (2012). Novel polyethersulfone nanocomposite membrane prepared by PANI/Fe3O4 nanoparticles with enhanced performance for Cu (II) removal from water. *Journal of Membrane Science*, *415*, 250-259. https://doi.org/10.1016/j.memsci.2012.05.007
36. Rajiv Gandhi, M., Vasudevan, S., Shibayama, A., & Yamada, M. (2016). Graphene and graphene-based composites: a rising star in water purification-a comprehensive overview. *ChemistrySelect*, (1), 4358-4385. http://cecri.csircentral.net/id/eprint/3162
37. Horzum, N., Demir, M. M., Nairat, M., and Shahwan, T. (2013). Chitosan fiber-supported zero-valent iron nanoparticles as a novel sorbent for sequestration of inorganic arsenic. *RSC advances*, 3(21), 7828-7837. https://doi.org/10.1039/C3RA23454A
38. Yu, L., Ruan, S., Xu, X., Zou, R., and Hu, J. (2017). One-dimensional nanomaterial-assembled macroscopic membranes for water treatment. *Nano Today*, 17, 79-95. https://doi.org/10.1016/j.nantod.2017.10.012
39. Ding, H., Zhang, J., He, H., Zhu, Y., Dionysiou, D. D., Liu, Z., and Zhao, C. (2021). Do membrane filtration systems in drinking water treatment plants release nano/microplastics?.*Science of The Total Environment*, *755*, 142658. https://doi.org/10.1016/j.scitotenv.2020.142658
40. Huang, J., Huang, G., An, C., He, Y., Yao, Y., Zhang, P., and Shen, J. (2018). Performance of ceramic disk filter coated with nano ZnO for removing Escherichia coli from water in small rural and remote communities of developing regions. *Environmental Pollution*, 238, 52-62. https://doi.org/10.1016/j.envpol.2018.03.008
41. Ali, S., Rehman, S. A. U., Luan, H. Y., Farid, M. U., & Huang, H. (2019). Challenges and opportunities in functional carbon nanotubes for membrane-based water treatment and desalination. *Science of the Total Environment*, 646, 1126-1139.

https://doi.org/10.1016/j.scitotenv.2018.07.348
42. Senthil, R. A., Wu, Y., Liu, X., & Pan, J. (2021). A facile synthesis of nano AgBr attached potato-like Ag2MoO4 composite as highly visible-light active photocatalyst for purification of industrial wastewater. *Environmental Pollution, 269*, 116034. https://doi.org/10.1016/j.envpol.2020.116034
43. Monsef, R., Ghiyasiyan-Arani, M., & Salavati-Niasari, M. (2018). Application of ultrasound-aided method for the synthesis of NdVO4 nano-photocatalyst and investigation of eliminate dye in contaminant water. *Ultrasonics sonochemistry,* 42, 201-211. https://doi.org/10.1016/j.ultsonch.2017.11.025
44. Maria-Hormigos, R., Pacheco, M., Jurado-Sánchez, B., &Escarpa, A. (2018). Carbon nanotubes-ferrite-manganese dioxide micromotors for advanced oxidation processes in water treatment. *Environmental Science:* Nano, 5(12), 2993-3003. https://doi.org/10.1039/C8EN00824H
45. Dankovich, T. A., & Gray, D. G. (2011). Bactericidal paper impregnated with silver nanoparticles for point-of-use water treatment. *Environmental science & technology*, 45(5), 1992-1998. https://doi.org/10.1021/es103302t
46. Tara, N., Siddiqui, S. I., Rathi, G., Chaudhry, S. A., &Asiri, A. M. (2020). Nano-engineered adsorbent for the removal of dyes from water: A review. *Current Analytical Chemistry,* 16(1), 14-40. https://doi.org/10.2174/1573411015666190117124344
47. Su, Y., Adeleye, A. S., Huang, Y., Zhou, X., Keller, A. A., & Zhang, Y. (2016). Direct synthesis of novel and reactive sulfide-modified nano iron through nanoparticle seeding for improved cadmium-contaminated water treatment. *Scientific reports,* 6(1), 1-14. https://doi.org/10.1038/srep24358
48. Islam, M. A., Ali, I., Karim, S. A., Firoz, M. S. H., Chowdhury, A. N., Morton, D. W., & Angove, M. J. (2019). Removal of dye from polluted water using novel nano manganese oxide-based materials. *Journal of Water Process Engineering*, 32, 100911. https://doi.org/10.1016/j.jwpe.2019.100911
49. Das, L., Das, P., Bhowal, A., and Bhattachariee, C. (2020). Synthesis of hybrid hydrogel nano-polymer composite using Graphene oxide, Chitosan and PVA and its application in waste water treatment. *Environmental Technology & Innovation*, 18, 100664. https://doi.org/10.1016/j.eti.2020.100664
50. Jabeen, H., Kemp, K. C., and Chandra, V. (2013). Synthesis of nano zerovalent iron nanoparticles–graphene composite for the treatment of lead contaminated water. *Journal of environmental management*, 130, 429-435. https://doi.org/10.1016/j.jenvman.2013.08.022
51. Crane, R. A., and Scott, T. B. (2012). Nanoscale zero-valent iron: future prospects for an emerging water treatment technology. *Journal of hazardous materials*, 211, 112-125. https://doi.org/10.1016/j.jhazmat.2011.11.073
52. Alheshibri, M., Qian, J., Jehannin, M., and Craig, V. S. (2016). A history of nanobubbles. *Langmuir,* 32(43), 11086-11100. https://doi.org/10.1021/acs.langmuir.6b02489
53. Hu, L., and Xia, Z. (2018). Application of ozone micro-nano-bubbles to groundwater remediation. *Journal of Hazardous Materials,* 342, 446-453. https://doi.org/10.1016/j.jhazmat.2017.08.030

54. Atkinson, A. J., Apul, O. G., Schneider, O., Garcia-Segura, S., and Westerhoff, P. (2019). Nanobubble technologies offer opportunities to improve water treatment. *Accounts of chemical research,* 52(5), 1196-1205. https://doi.org/10.1021/acs.accounts.8b00606
55. Westerhoff, P., Alvarez, P., Li, Q., Gardea-Torresdey, J., and Zimmerman, J. (2016). Overcoming implementation barriers for nanotechnology in drinking water treatment. *Environmental Science: Nano, 3*(6), 1241-1253. https://doi.org/10.1039/C6EN00183A
56. Kumar, S., Ahlawat, W., Bhanjana, G., Heydarifard, S., Nazhad, M. M., and Dilbaghi, N. (2014). Nanotechnology-based water treatment strategies. *Journal of nanoscience and nanotechnology, 14*(2), 1838-1858. https://doi.org/10.1166/jnn.2014.9050
57. Arumugham, T., Amimodu, R. G., Kaleekkal, N. J., and Rana, D. (2019). Nano CuO/g-C3N4 sheets-based ultrafiltration membrane with enhanced interfacial affinity, antifouling and protein separation performances for water treatment application. *Journal of Environmental Sciences, 82*, 57-69. https://doi.org/10.1016/j.jes.2019.03.001

ISBN: 978-93-90847-02-0

9. Plastic pollution: A Global Challenge and it's Prevention

Tanmay Ghosh

Assistant Professor,
Department of Microbiology,
Dinabandhu Andrews College,
Baishnabghata, South 24 Parganas,
Kolkata, West Bengal, India.

Abstract:

Plastic is one of the most important goods to the modern civilization as well as plastic pollution is a great headache to us. This is the inventions of people who are always looking for new and better content because plastic fulfill the desirement of cost-effective good quality products and that is why they are braided today. Through all over the world plastic is used in many ways as bottle, carry bag, toy and also another type of goods. According to the survey report of plastic waste only nine percent (9%) of the nine billion tons of plastic in the world ever produced has been recycled. Plastic degradation closes to impossible because in burning of plastics toxic gases blow off, it takes a very long time to degrade but till then plastic cannot be completely destroyed. In case of through out to seas or oceans it turns into micro plastic, but it does not leave to create pollution. The world has already started to suffer from plastic pollution, as effects almost species are on the way of extinction. Due to plastic waste affect 84% of sea turtles, 44% of sea birds, and 43% of all marine mammals out of 267 suffering from starvation, suffocation, and other critical conditions. So, to get rid of plastic pollution, people should have to pay more attention to the friendly process to meet their requirements otherwise one day will come when there is no footprint of human beings on the earth.

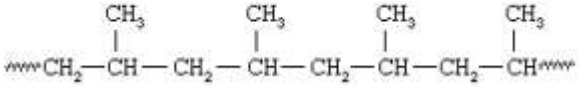
9.1 Introduction:

Plastic is a groundbreaking invention of science because plastic is such a substance that is very light in weight, limitless longevity, low-cost products and contain multipurpose utilization properties. Due to these qualities the use of plastic has spread very fast through all over the world. The production and gathering of plastic carry bags has been started after the 2nd World Wer and now nothing can retard its motion. From bottle cap to doll, from cosmetics to electronics and from chocolate rapper to grocery packets everywhere plastic spreads its kingdom. Now the days of modern technologies and transport systems people able to reach from peak of mountain too deep of ocean and everywhere they through plastic rappers, bottles, carry bags etc that cause gathering here and there. Plastic pollution is the gathering of plastic materials in the Earth's environment that adversely affect humans, wildlife and wildlife habitat. Everyday approx. one million tone plastic is removed from houses, industries worldwide and it is a common thing to have unnecessary plastic bags in roads and drains but there is no process to destroy this large amount of plastic. They exist depending on their precursors and method for their polymerization.

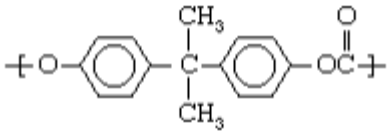
The main contributory factors to the problem of plastic pollution are fishing nets, plain old trash, disposing of plastic and garbage, and over-utilization of plastics. Plastic that acts as pollutants can be classified into big to microscopic according to their sizes as - Micro debris, Macro debris and Mega debris, meso debris. Mega and micro plastics are generally used in manufacturing packaged products. Due to fishing activities some type of plastics are accumulated in the remote islands those are called micro plastic, meso plastic etc. In India per year around 5.6 million tons of plastic is produced as garbage in which about 70% is considered as waste which have no use. This limitless use and reckless throwing of plastic anywhere create problems in drainage of water, damage soil quality that causes agricultural hazards and it also cause a great impact on the ecosystem. If the modern civilized people pay no attention on this severe problem, the day is not so far when human beings will be in the list of extinction.

9.2 Chemistry of Plastic:

Plastic us polymeric substance. Plastic has the ability of being molded by applying heat and pressure. This property of plasticity, often found in combination with other special properties such as low density, low electrical conductivity, transparency, and toughness, allows plastics to be made into a great variety of products. The different types of plastics are Polyvinyl chloride (PVC), Polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET) etc. In the field of chemistry plastic polymer is classified into two groups due to their polymeric chain - Aliphatic polymer and Heterochain polymer. In aliphatic polymer its backbone is made up with liner carbon chain.



And in the Heterochain polymer the backbone is made up with aromatic ring with the attachment of nitrogen, sulfur or oxygen molecules.



Most plastic is formed from the end product of petroleum which main component is lipid. But in long ago the presence of lipase enzyme producing microorganisms was discovered that means plastic should be degraded naturally. But in reality, its opposite matter is happened. So why plastic is not biodegradable which causes pollution? Most of the plastic is derived from propylene that's a simple chemical component of petroleum.

When it is manufactured in industries, propylene is mixed with some other needed compounds and heated with catalysts in very high temperature, by which individual propylene monomers bind together and form long polymeric chain of very strong carbon-carbon bond.

This mechanism is totally unnatural, so plastic is not biodegradable. To degrade this polymer when it is burned its compositions form toxic gaseous substances that cause air pollution. If polymer would be made up with peptide bonds, it would never cause pollution, but industrialists avoid it because peptide bond is degradable by microbial actions, then self-life of the product would be very limited.

9.3 Causes of Plastic Pollution:

Plastics are the most hazardous non decomposable material. In modern world use of plastic increases tremendously as well as the rate of pollution also increases vulnerability. There are lots of causes of plastic pollution, few are listed below-

9.4 Use of Plastic as Carry Bag:

As I mentioned earlier the composition of plastic vary and the chemical structures of plastic and its thickness also different.

Fish is a protein rich food source fishing is a source of income. There are several types of net use to catch the fish from water bodies. Most of the rope and net that uses for fishing activities are made up of plastic like nylon to make the equipment durable. This plastic net sometimes cuts into the water bodies and effects on coral reefs. Some of plastic that release several toxins which affects the ecosystem of water and indirectly effects on human being too. Largest ocean-based source. Plastic contamination which is discarded fishing gear traps and nets are included, and it is estimated up to 90% of plastic debris in some areas. Continental plastic is mainly from water runoff or direct stream.

9.5 Disposition of Household Plastic Garbage:

Nowadays from day to night we use enumerous things made up of plastic. We can say plastic is our all-time usable material in different way. It is non disposable, do not break down cause's environment pollution. The polymer of plastic takes long period of time to degrade. The decaying of plastic is a long process. A plastic container takes about 450year to degrade, a nappy takes 400years, a plastic foam takes 50years. So, the plastic wastes that mixed with soil causes soil pollution as a result day by day agricultural field get polluted. Burning of plastic causes worst effect on environment.

It releases a highly toxic chemicals which deadly effect on human health. When this plastic mixed with groundwater, the water become highly poisonous. Most of the area now contaminated by plastic toxin. As a result, people suffer by numerous illnesses, Lifespan decreases. When rainfalls, all these plastic wastes toxin leaches everywhere. Oceans have susceptible adverse effects on plastic wastes that causes marine ecosystems hamper. We consume this poison fish for nutritional source, but we don't think about the pollution that happened earlier which effect on fish.

9.6 Plastic in Soil:

Plastic waste is usually dumped in landfills. There is highly chance of formation of highly chemical in the soil. When these chemicals are leaches inti underground, water quality reduces. The wind contributed to plastic pollution, which means plastic wastes unknowingly spread from another place to another place.

Plastic wastes are coming in contact with trees, fences, towers, poles, traffic lights, roof etc and suffocate them and leading to their death . Still now there are number of open garbage dump in the world even in developed country too. That leads to pollution and causes environmental stress. Plastic pollution of land poses a great worst effect on plant , animal and human beings.

Chlorinated plastic release highly dangerous toxic which can then the seeps into land and also in groundwater.

Thereafter water become polluted . Such toxic chemicals are released from plastic waste interact with water entered in the soil, it makes the soil barren and affects tree growth.

Landfill located near the ocean often contributes to the ocean debris because the content is easily swept and is transported by sea or by sea waterways like rivers and streams. Marine debris sewage can also result from water that is not has been treated efficiently.

9.7 Effect of Plastic Pollution:

9.7.1 Environmental Effects of Plastic Pollution:

Plastics can be composed of major toxic pollutants that have potentiality and important in environmental pollution in the form of water, air and land. Plastic is a non-biodegradable substance that creates a disaster on our beautiful nature results long- terms problem for animals, humans, and plants etc. Too much use of plastic is responsible for the changes of wind, ocean currents, urban areas, trade routes and coastlinegeography. The huge population of human is responsible for this pollution. Generally, plastics are found in the towns, crannies of cities, enclosed regions etc. Plastics pollution effects on our natures are ground water pollution, land pollution, air pollution, killing of animals, distraught of food chain etc.

9.7.2 Health Problems Due to Plastic Pollution:

Plastic pollution take place when plastics are collects in a place begins to a bad effect on the beautiful environment and then start problem for wildlife, plant and also in the human growth. These pollutions are also involved in local animals, decreasing in humans, destroy the plant life etc. Plastic is an unbelievable useful material in our society and daily life which can impact a bad role in our life.

Plastic is also breaking hormonal growth and carcinogens. The chemicals that are used for the preparation of plastics have some known human health effects which encompasses reproductive, neurological, immune system impairment, cancer, leukemia, genetic impact, developmental toxicity and also impact in the newborn baby like low birth weight. Day by day huge production of plastics impact in water, air, soil and many other pollutions. The application of plastic products generally leads to the ingestion of huge amount of both toxic substances and micro plastic particles with carcinogenic or endocrine disrupting effects. This is also connecting with the human health & hygiene.

In this beautiful nature, the micro plastics are insert to our body through direct exposure which include necrosis, dizziness, apoptosis, diabetes, cardiovascular disease, stroke, unconsciousness, arthritis etc.

9.7.3 Prevention:

Plastic wastes increases day by day with high rate. Nature suffocates in pollution. A global plastic pollution will wait in future. So, from now we have to take prevention against it. We have to protect us and protect our environment. We should take action for a plastic free environment; we can breathe fresh air and be healthy. Some measure reducing plastic pollution are following

9.7.4 Reuse:

We should avoid the use of plastic in daily life. There are several options instead of plastic. We can use wooden bottles in place of Plastic, it is eco-friendly as well as good for health. We should we paper carry bag in place of plastic. In shop we should choose reusable container for packaging instead of plastic bag. If we ignore the use of plastic little more, one day we may achieve a plastic free environment.

9.7.5 Recycle:

Plastic can be recycled by using it into a new form in new product. Recycling of plastic means still it’s a plastic because plastic is not easily degradable. So, by recycling the load of plastic never decreases but there is a chance to balance the amount of plastic instead of increasing it. Here a problem arose that all types of plastic can’t be recycled to new product .so the best way to reduce plastic is by avoiding the use of plastic.

Proper education: Education is the most important solution of almost all the problem. If we have knowledge about the harmful effect of plastic, then we might avoid it.

In the business field it is very important to aware against the harmful effect of it. So that they can choose a replaceable option of plastic. Each of us should have knowledge of plastic bad effects.

Government Intervention: Government should be more aware to the plastic wastes. If government, make a law against plastic general people definitely follow it. Government of many countries already looking after it. There are many antiplastic association who aware people. By different ways. They camp in locality.

9.8 Conclusion:

Plastic is such a daily used essential commodity that the human beings neither can stop its use, nor they can save their existence if they will not stop plastic pollution. Evolutionary human beings are the most powerful and knowledgeable creature in the earth, nothing is impossible to them but this nonliving material, plastic changes many things of this modern civilization and now many critical diseases are occurring only for the cause of plastic pollution. So, it can be concluded that the industrialists are manufacturing more and more essential items, but they must pay attention on the recycling of wasted plastics. Otherwise, there will be no existence of human creatures on the earth.

9.9 Reference:

1. McConnel, D.; Steer D.; Knight, C. and Owens, B. (2010). The Good Earth:Introduction to Earth Science, SecondEdition, McGraw-Hill Companies, NewYork, pp. 316.
2. Phillips, A. (2019). Plastics and use of Oxo-Biodegradable, The Guardian Newspaper, (Vol.48 No. 56, pp.44).
3. Uwaegbulam, C.; Nwannekanma, B. and Gbonegun, V. (2018). Producers' Responsibility and Plastic Pollution Crisis, The Guardian Newspaper, (Vol. 35 No. 14350, pp.32-33).
4. Fellman, J.D.; BJelland, M.D.; Montello, D.R.; Gettis, A. and Gettis, J. (2013). Human Geography: Landscapes of Human Activities, Twelfth Edition, McGraw-Hill Companies, New York, pp.431.
5. Carson, H.S., Colbert, S.L., Kaylor, M.J.andMcDermid, K.J. Small plastic debris changes water movement and Heat transfer through beach sediments'. Marine Pollution Bulletin [online]. 2011; 62(8):
6. 1708-1713.6. Plastics in the Ocean Affecting Human Health, Gianna Andrews, Geology and Human Health, Topical Resources, 7th March 2018
7. The Known unknown of Plastic Pollution, the environment, 3rd March 2018
8. Walker, T.R., Reid, K., Arnould, J.P.andCroxall, J.P. Marine debris surveys at Bird Island, South Georgia 1990–1995. Marine Pollution Bulletin, 1997; 34(1), 61-65. https://doi.org/10.1016/S0025-326X(96)00053-7
9. Mckenzie J, Mcintosh R, Baylis A and others (2004) Entanglement of Australian sea lions and New Zealandfur seals in lost fishing gear and other marine debrisbefore and after government and industry attempts toreduce the problem. Mar Pollut Bull 49: 33−42
10. Tanaka K, Takada H, Yamashita R, Mizukawa K, FukuwakaMA, Watanuki Y (2013) Accumulation of plastic-derivedchemicals in tissues of seabirds ingesting marine plastics. Mar Pollut Bull 69: 219−222

11. Winston J, Gregory M, Stevans L (1997) Encrusters, epibionts, and other biota associated with pelagic plastics:a Review of biogeographical, environmental, and conservation issues. In:Coe J, Rogers D (eds) Marine debris: Sources, impacts, and solutions. Springer Verlagl, New York, NY, p 81−97
12. Wegner A, Besseling E, Foekema E, Kamermans P, Koelmans A (2012) Effects of nanopolystyrene on the feedingbehavior of the blue mussel (Mytilusedulis L). EnvirontoxicolChem 31: 2490−2497
13. Verlis KM, Campbell ML, Wilson SP (2013) Ingestion of Marine debris plastic by the wedge-tailed shearwater Ardennapacifica in the Great Barrier Reef, Australia.MarPollut Bull 72: 244−249
14. SC, Archibald K, Morgan G, Morgan L (2011) The use of plastic debris as nesting material by a colonial seabird and associated entanglement mortality. Mar Pollut Bull 62: 168−172

ISBN: 978-93-90847-02-0

10. Polythene: Problems and Solutions

Dr. B. Mallesh Reddy

Assistant Professor,
Shree Shivaji Arts,
Commerce & Science College, Rajura,
Chandrapur, Maharashtra.

Polythene (Polyethylene or Polymethylene) is one of the important and great inventions. Because of its significant properties like water resistance, electric resistance, high ductility, lightweight, and less toxicity, polythene is widely used in various domestic and industrial products.

But due to its improper and overuse, it became a serious problem. Now the entire world is concerned with polythene pollution.

Polythene is a type of plastic that can be molded into various shapes. It consists of nonpolar, saturated, high-molecular-weight hydrocarbons.

Chemically polythene is a group of synthetic polymers with general formula $(C_2H_4)n$. It is produced by polymerization of ethylene, which is mainly obtained from petroleum or natural gas.

Polyethylene was first synthesized by Hans von Pechmann in 1898, and the first industrially practical polyethylene was developed by Eric Fawcett and Reginald Gibson in 1933.

But the commercial production of industrial polythene was started in 1939 by the synthetic process developed by Michael Perrin.

10.1 Properties:

- Polyethylene is a thermoplastic, that means, on heating it becomes soft and malleable (plastic) rather than burning and become hard and solid on cooling. This process can be repeated several times with polyethylene.
- It melts between 105 to130 °C, and some types can withstand up to 146 °C. Combustion typically occurs above 349 °C.
- Its optical density can vary between almost clear, milky-opaque, and opaque.
- Polyethylene is of low strength, hardness, rigidity, and friction, but has a high impact strength and ductility.
- Polythene is insoluble in water and can resist several other solvents, and it can be dissolved in toluene, xylene, trichloroethane or trichlorobenzene at high temperature.
- Polythene is a bad conductor of heat, but due to its malleable nature, it can't be used as heat resistance or heatproof material.
- It is nonpolar and a bad conductor of electricity, hence it is readily used as an electric insulating material and also offers good electrical treeing resistance.

10.2 Uses:

Polythene is one of the most widely used plastic in industrial as well as domestic materials. The primary use is to make carry bags for groceries, medicines, fruit and vegetables, and garbage.

It is also majorly used in the packing of various types of materials at industrial and retail levels. Now a day's almost all processed foods and drinks are packed with this polythene. Other than this, polythene is also used in the insulation of cables and wires. It is also present in Adhesive tapes and packing films.

Various household products like crates, trays, bottles for milk, water, and fruit juices, caps for containers, cans, and drums contain polyethylene. Polythene is used in water pipes and hoses for pipes and fittings manufacturing. It is also used in refrigerator trays or shelves, kitchen racks, etc.

Different types of toys play kits, baby shoes, and diapers also contain polyethylene contents. It is also used in outdoor playground furniture, golf-ball covers, and other sports materials.

In agriculture, polyethylene is used to make mulching films, greenhouse covers, silage films, cultivation trays, irrigation pipes, bird and fish nets, etc. Pesticide cans seed bags and fertilizer bags are also coated with polyethylene.

Polythene is molded into fibers and used in making of certain types of ropes, curtains, and modern protective cloths. It is also used in jacket backing and carpet backing.

Lightweight, chemical inertness, and impermeable nature make polyethylene ideal for various medical instruments specifically catheter tubings and coil hoops. It is also used for coating various medical and radiological equipments.

Due to better clarity, improved heat seal temperature range, and superior seal strength, Polyethylene, and other modified PE material are also commonly used in the medical field.

10.3 Limitations:

- The origin materials of polythene are petroleum and natural gas, which are non-renewable, hence it become rare and costlier in the future.
- Polythene is non-degradable or very slowly degradable.
- It is easily flammable, hence can't be used in high temperature and high friction areas.
- It has very poor weathering resistance, which can reduce the life of the material.
- Poor thermal resistance and subject to stress cracking

10.4 Problems:

However, polythene is a very useful material with excellent features, but its overuse and improper use make it one of the major pollutants at the universal level.

All most all countries are concerned with the management of polythene pollution. Presently polythene is the most concerned pollutant on the earth as it pollutes all types of habitats and interferes with the life processes of various organisms.

The use of polythene is increasing every year and most of these polythene materials like carry bags, trash bags, water bottles, pickings of food and grocery, etc are non-reusable (one-time use materials). So, they get accumulated in landfills. Presently polythene represents a major portion of the municipal solid waste of every small and big city. The polythene is non-biodegradable or very slowly degradable, hence accumulates in landfills.

In addition to stacking, they also release toxic substances into the soil and water when perish under sunlight. These harmful chemicals released by polythene leaching enter deep into the soil and pollute the groundwater.

Due to their thin size and lightweight, polythene bags and packing wrappers can easily be blown by the wind and spread to long distances. Hence, they are present everywhere in the villages, agriculture fields, roadsides, ponds, lakes, and forest sites.

From land, these polythenes enter into the water channels, then to rivers, and finally end up in the oceans. Our rivers are acting as carriers for the plastics into oceans, where it forms mountains of plastics. All most sea beaches and islands are polluted with these polythene materials.

Now the polythene is ubiquitous, present everywhere from the Arctic to Antarctica.

Polythene materials specifically polythene bags accumulate in gutters and clog the drainage channels. It creates waterlogging, foul odor and may lead to artificial floods in cities. They also form stockpiles on roadsides, in ditches and small pools, and act as a breeding ground for mosquitoes.

Polythene pollution poses a bigger threat to plants and animals also. Polythenes get accumulated on aquatic bodies may reduce or prevent the entry of sunlight into the water and leads to the destruction of aquatic flora. It also reduces the diffusion of oxygen into the water and kills fishes and other aquatic organisms due to hypoxia.

Millions of animals are killed by plastics every year either due to engulf or entangled in. Many marine organisms like fishes, whales, sea turtles, etc. get confused with polythene as their food and engulf it. All most all sea birds eat plastic one or another time. The consumed polythene may stick in their digestive system and leads to the death of the organisms. There were instances where large, endangered tortoises were found to have suffocated because of swallowing of plastic bags. Animals entangled in the marine debris of plastic bags face starvation, choking, laceration, infection, and can give up their last breath. Even the planktons, the producers of the aquatic ecosystem are also bearing the pressure of these polythenes in the aquatic bodies.

Cattles and other street animals also eat polythene along with the food and get into the problem. Polythene affects the digestive system and reproductive system of these animals.

Polythene bags and films accumulate in the soil and form a thick layer of plastic on the surface or just beneath the topsoil. These layers interfere with the water and gas budget of the soil. They may reduce water percolation and can alter water evaporation. These layers may also affect exchange of gasses.

Polythene also shows its terrible impact on agriculture and forests. Polythene films in the soil decrease soil porosity and air circulation. Polythene layers in the soil also interfere with seed germination, seedling establishment, water, and mineral absorption by roots. It also alters soil microbiota and reduces soil fertility.

On exposure to solar radiation, the plastic produces methane and ethylene, which are considered dangerous greenhouse gases. Burning of plastic releases toxic substances like furans, dioxins, and polychlorinated biphenyls into the air and cause ambient air pollution.

These chemicals and black soot coming from plastic burning may increase the risk of respiratory problems like asthma, skin problems, heart diseases and may promote several types of cancers.

Small pieces of plastic, less than 5 mm in length are called microplastics and less than a micron is called nanoplastics. These microplastics and nanoplastics are even more dangerous as they can easily mix with soil and can be easily engulfed by animals. These micros and nanoplastics enter into the food web through planktons and hampers all the forms of life. Microplastics have been detected in drinking water, food products including seafood and table salt. They are known to reduce fertility and vigor in fishes, birds, and other organisms. They can cause Sevier diseases and can alter the genetics of organisms including human beings.

10.5 Solutions:

Polythene is very harmful to plants, animals, human beings, and the environment. It has very terrible and long-term effects on nature. Hence it is very necessary to reduce the use or to find some better alternatives to the polythene.

10.6 Reduce and Reuse:

Avoiding the use of polythene is the best way to avoid the pollution caused by it. But now we are extremely addicted to polythene, hence it is better to use thick reusable polythene in place of single-use polythene stuff. The reusable objects can be used several times and can reduce a large amount of polythene litter. Instead of using a single-use water bottle, one can maintain a stainless steel or thick plastic bottle which can be refilled from any water unit.

The use of paper or cloth bags for carrying groceries, fruits, vegetables, etc. can also reduce polythene waste. Avoiding single-use coffee cups, straws, disposable cutleries also minimize everyday polythene litter.

Purchasing large packs of food items and other consumer goods instead of small packs is also useful to reduce polythene.

10.7 Promotion of Research:

Promotion of research and availing of funds to develop and test safe and alternative materials and discovering biodegradable pathways are useful to tackle the problem of polythene pollution.

10.7.1 Alternative Materials:

The development of alternative materials which can be used in place of plastic will be useful and can reduce polythene litter.

Presently, research is going on to develop plant-based plastics and biodegradable plastics, but it needs further comprehensive research to develop an affordable and sustainable alternative to plastic.

10.7.2 Biodegradation:

Biodegradable plastics can be decomposed into water and carbon dioxide by the action of living organisms.

Among all other methods used for lowering down the polythene littering, biological degradation appears to be the most promising and permanent method.

Certain organisms have specific enzymes to digest the polythene and use it as a source of carbon.

Some of the bacteria like *Pseudomonas fluorescens*, *Sphingomonas*, *Brevibacillus borstelensis*, *Acinetobacter sp.* and some other organisms like Indian mealmoth larvae, the caterpillar of *Galleria mellonella* have the potential to digest several types of plastics.

Further investigation and detailed study of these organisms and the degrading enzymes will provide a safe and sustainable way to digest polythene materials.

10.8 Waste Management and Recycling:

Most of the polythene materials can be recycled and reused if managed properly. Recycling keeps plastic out of landfills and oceans and can also reduce the addition of new plastic into circulation.

Use of the used polythene to make roads or any other permanent constructions can sink these materials for a very long period.

Moreover, the used polythene can be used to prepare plastic cement and other base chemicals which can be used in chemical industries. But it needs the development of a proper sustainable model for plastic waste management at various levels like towns, cities, and metro cities.

10.9 Rigorous Rules:

The problem of polythene has burgeoned into a global crisis that requires immediate and sustained attention and action. Development and strict implementation of strict laws regarding the manufacturing, use, and management of polythene is very necessary.

Ban on single-use plastic at the local, state, and national levels helps to minimize polythene waste. Imposing heavy taxes, mandating a buy-back system for polythene manufacturing companies are also necessary.

10.10 Awareness:

Educating the people and spreading awareness about polythene pollution and its impact on health and the environment is also very necessary. Conducting programs on polythene pollution at school, college, and higher education levels can bring awareness among the students and can change their behavior towards the use of plastic. Making videos and short films showing the impact of plastic on wildlife and habitat will also be useful to provoke people to rethink the issue.

ISBN: 978-93-90847-02-0

11. Volatile Organic Compounds (VOCs): An Overview

Dr. Arpan Manna

Assistant Professor,
Department of Chemistry,
Tarakeswar Degree College,
Tarakeswar, Hooghly.

Abstract:

Volatile organic compounds (VOCs) are the organic compounds that evaporate very easily and are dangerous for the atmosphere. VOCs may be either naturally occurring or man-made. They are warmed up due to human activities like industrialization, aerosol sprays etc.

There are several and they pose a great danger to human beings. VOCs are common in modern life, from the paint on walls to the gases emitted by cars. Because these gases evaporate easily and accumulate in the atmosphere, they contribute a great deal to urban heat island effect. In the present Chapter, attempts have been made to assess the role of VOCs as a major contributor to air pollutants. We have discussed their role in atmospheric chemistry, measurement challenges and methods to control them in air.

11.1 Introduction to VOCs:

Many of the most common air pollutants created by chemical and petrochemical industries are Volatile Organic Compounds (VOCs). Volatile organic compounds (VOCs) are chemicals that slowly evaporate at room temperature i.e., these compounds possess high vapour pressure. Organic compounds are defined as any compound containing carbon. In addition to carbon, other elements may be present in the compound. Organic compounds may contain hydrogen, halogens (e.g., chlorine, fluorine or bromine), oxygen, sulphur, phosphorus, silicon, or nitrogen. The only exception is carbon oxides and inorganic carbonates and bicarbonates.

VOCs can be either gaseous or liquid and belong to a variety of chemical classes, including alkanes, alkenes, and cyclic hydrocarbons. VOCs are used in many industrial applications, including coatings, adhesives, cleaning supplies, paints. One source of VOC chemicals in this industry is electric arc furnaces.

Typically, these VOC chemicals do not pose a serious threat to the environment. However, due to certain properties of these chemicals, if released into the atmosphere they contribute directly to air pollution and global warming. For example, some volatile organic solvents that are used in certain installations also produce ozone precursors which can react with oxides of nitrogen in presence of sunlight and consequently, produce greenhouse gases which harms the ozone layer.

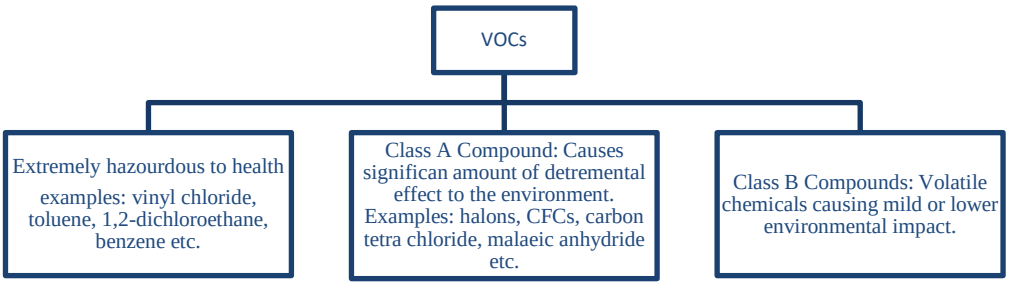
The side effects of volatile organic compounds on human health can consist of respiratory system diseases, cardiovascular and gastrointestinal diseases, eyesight problems and skin diseases. Volatile organic compounds are hepatotoxic, nephrotoxic, neurotoxic and carcinogen.

Of serious environmental concern are volatile organic compounds (VOCs) because of the harmful properties that they exhibit in varying degrees. These harmful effects can be summarized as follows:

- Cause direct toxicity to human health
- involvement in photochemical ozone generation at ground level, with consequent detrimental effects
- depletion of stratospheric ozone
- contribution to global climate change

11.2 Classification of VOCs on the Basis of its Harmfulness:

The term VOCs imply a range of chemical classes, including aliphatic, aromatic and chlorinated hydrocarbons; aldehydes; ketones; esters; ethers; acids; and alcohols. Many companies contribute directly or indirectly to environmental issues and concerns, but the nature and extent of their contributions depend on the chemical used. Existing guidance for Environment Agency Inspectors is given in a series of Process Guidance Notes. These divide VOCs into three categories:



However, the above three categories fail to encompass all types of VOCs. The Categorization of the unlisted VOCs depends on the judgement of the individual inspector of the environmental agencies.

A variety of methods or rules has been applied to categorize the unlisted VOCs and however, the vastness of the volatile compounds from both biogenic, anthropogenic sources resist to do so.

11.2.1 Sources of VOCs:

Through the use of a global model, it was found that natural emissions of non-methane hydrocarbons (NHMC) and VOCs exceed anthropogenic emissions. However, in urban areas, anthropogenic sources often dominate.

11.2.2 Natural Sources of Volatile Organic Compounds:

VOCs are present in a variety of natural sources, including trees, grasses, and even ocean waves. These types of VOCs can also be termed as biogenic volatile organic compound (BVOC).

BVOC (Biogenic volatile organic compound) is a chemical released into the air by plants. Biogeochemical cycling is the movement of chemicals between the biosphere and geosphere. The biosphere includes all living organisms. The geosphere consists of rocks, water, and soil. Soil is an important part of biogeochemical cycles in that it contains a large amount of organic matter which is broken down by microorganisms. This breakdown process releases carbon dioxide (CO_2) into the atmosphere as well as some volatile organic compounds (VOCs). VOCs are gases that easily convert biogenic volatile organic compounds (BVOCs) are a component of the natural atmosphere. In general, flowers and fruits emit the widest variety of BVOCs. These levels peak when the plants are mature.

Woody plants are more likely to release a diverse mixture of terpenoids, which includes isoprene, monoterpenes, sesquiterpenes and diterpenes. On the other hand, whereas grass like plants release comparatively huge quantities of oxygenated BVOCs along with little monoterpenes. When plants are damaged, the emissions of these compounds may be increased and other compounds may be released, which are known as green leaf volatiles which contains mainly long chain aldehydes and ketones etc. They include a variety of chemical compounds such as alcohols, acids, esters, and sulphur-containing gases. These substances play an important role in many ecosystems. BVOCs like terpenes, methyl jasmonate and methyl salicylate etc. are released from the tree leaves during abiotic as well as biotic stress on the woods. One might be familiar with BVOCs in their destructive forms: the stench from rotting vegetables or a skunk's spray are both unpleasant results of decomposition by microorganisms that produce BVOCs as metabolic by-products.

11.2.3 Why does plant synthesize BVOCs?

From the above discussion, it’s clear that a large number of volatile organic compounds are synthesized and emitted into the atmosphere by plants. Several research have confirmed that there exists an interconnection between biosphere and atmosphere which control the biosynthesis of BVOCs. Emission of particular type of volatile compounds as well as its rate of emission have been directly related to the alteration in the gene expression of the plants, microarray analysis of the leaves, alteration of enzyme activities etc.

Biosynthetic pathways of several BVOCs are not only limited to the physiological factors of the plants but also it depends on the physicochemical constrictions like temperature, atmospheric pressure over leaves, partial pressure.

Atmospheric effects like moisture availability in soil, concentration of greenhouse gases in the atmosphere, quantity of dust particles in the air, condition of ozone layer in the stratosphere etc. significantly influence the production and release of BVOCs from the plants. Flux density of sun light controls the rate of emissions of volatile compounds from leaves directly and indirectly.

11.2.4 Anthropogenic Sources of VOCs:

There are three main groups of anthropogenic VOCs. These include NHMCs, OVOCs and halogenated hydrocarbons. [e.g., Chlorofluorocarbons (CFCs); Hydro fluoro carbons (HFCs)].

a. In urban areas, vehicle emissions are the main contributors to ambient volatile organic compounds. Fumes coming from liquid fuels containing aromatic compounds are emitted to the air; most of these aromatic compounds are added to gasoline for antiknock purposes, such as lead replacement.

b. Climatic, soil and vegetation changes have been shown to affect the rates and pathways of C release from organic matter, but the role of oceans has received little attention. The major sources of marine organic carbon (OC) include planktonic and benthic production, as well as inorganic material and detritus from terrestrial sources.

Since the beginning of the industrial age, emissions of alkanes and alkenes have been dominated by anthropogenic sources, but also produced by soils, wetlands, and oceans.

c. Methanol, acetone etc. are the oxygenated hydrocarbons that are associated to vegetation, but also are emanated by combustion of fossil fuel. Methanol has a range of applications other than as a fuel additive. Acetone is used for industrial applications, as an antifreeze agent, an ingredient in nail polish remover, and a solvent in the paint industry.

These species play a role in both the global energy balance and climate change. The data set, which includes measurements from diverse locations around the globe, reveals that these two species can serve as useful tracers of the source of atmospheric CO, the most important greenhouse gas emitted by human activities.

d. Halogenated hydrocarbons are derivatives of hydrocarbon which include halogen (mainly fluorine and chlorine) in its structure. Toxic halogenated hydrocarbons include chloroform, a solvent; trichlorobenzene, used in the manufacture of dyes; PCBs and Dioxins, which are industrial by-products; hexachlorobutadiene, a major component of creosote and an unwanted ingredient in the manufacture of hydraulic fluid; and vinyl chloride, a precursor to PVC.

There are also a number of chemicals used as insecticides like DDT, lindane, aldrin etc. which contains halogenated hydrocarbons.

e. Methane is a greenhouse gas that is released in large amounts during the production of energy and as a result of human waste. It is also emitted by animals, particularly from cattle farms.

Summarily, it can be concluded that automobile emission and industrial waste are two major contributors to anthropogenic VOCs.

11.3 VOCs: What Role do they Play in Ecosystem?

11.3.1 Role of BVOCs:

a. Due to toxic, repellent, deterrent characteristics of some BVOCs released from flowers, leaves and roots can prevent or eliminate microorganisms. A new study shows that when maize roots are attacked by insects, a sesquiterpene compound is released.

b. In order to protect themselves from herbivores, plants have evolved a wide array of chemical defences. To defend themselves against these herbivores, plants use a variety of volatile organic compounds (VOCs). These VOCs can directly activate herbivore defence mechanisms or may prime a subset of defence-related genes for earlier and/or stronger induction on subsequent defence.

c. For flowering plants, creating seeds is essential for their survival. In order to achieve this, these plants release a multitude of BVOCs to attract the pollinators they need. An international team of researchers has found that exogenous application of isoprene promotes early flowering in barley (Hordeum vulgare) and oilseed rape (Brassica napus). Isoprene, a gaseous plant hormone, gives off the characteristic scent of pine trees.

d. BVOCs like isoprene and monoterpenes can shield the photosynthetic conduit of plants from impairment caused by momentary high-temperature episodes. These compounds accumulate in leaves during cool nights when the temperature is below optimum for photosynthesis. The next morning, when temperatures rise above optimum, some of these compounds are released. In plants, structural proteins are responsible for the formation of thylakoid membranes. Thylakoid membranes are made up of a system of stacked discs called thylakoids. These membranes have pores that allow the passage of molecules necessary for photosynthesis. When high heat is applied to them, they become leaky and lose their ability to produce energy efficiently. Isoprene that is released under stress from tree leaves strengthen the thylakoid membrane by increasing hydrophobic interactions between membrane proteins and lipids.

e. In biosphere, volatile organic compounds play an important role in the cycling of carbon and nitrogen, and thus are also involved in primary production. BVOCs quickly react with anthropogenic and natural compounds, as well as nitrogen oxides in the atmosphere. These reactions result in tropospheric ozone and photochemical smog. The dwelling time of greenhouse gases is increased due to the presence of BVOCs in the atmosphere. Consequently, secondary aerosols are formed in the atmosphere.

11.3.2 Role of VOCs from Anthropogenic Sources:

a. VOCs react with NOx in the presence of sunlight to form ground-level ozone, which is a component of smog. This substance can irritate your eyes, nose, throat and lungs. Smog is a serious problem in many metropolitan areas.

The presence of VOCs in the atmosphere has led countries to enact regulations to limit the total VOC emissions or to control specific VOCs that rise above a regulated threshold.

b. VOCs present in the air are an invisible killer. The soot and dust that are suspended in the air are only small particles of matter. The VOCs, on the other hand, are present in gaseous form and cannot be seen. They can cause serious damage to human health. One such gas is carbon monoxide. It is a poisonous gas that prevents blood from carrying oxygen to vital organs and tissues of the

c. There are many VOCs that can cause health problems, such as breathing disorders and cancer.

d. Volatile Organic Compounds (VOCs) are a major contributor to the urban heat island effect, which is when a city is significantly warmer than its surroundings.

11.4 Measurement of Quantity of VOCs in Air:

Measuring VOCs in air is a complicated task. The identification of VOCs in indoor/outdoor air requires specific methods, which are sensitive to low levels of VOCs and selective for the target compound. The method should be reliable and user friendly.

In order to determine the concentration of a specific volatile organic compound (VOC), you first need to know which VOCs are present. And that's not easy since there are many different VOCs and they're at low concentrations. Most VOC sensors are based on gas chromatograph (GC) technology, which is both expensive and time consuming. For example, GC-based sensors require a long warm-up time when turned on and produce an average measurement for the time period between turns on and off. Recently, researchers have tried to quantify the with required sensitivity by using sophisticated instruments like Gas Chromatography with Flame Ionisation Detector (GC-FID), Photo ionization detectors (PID), Proton Transfer Reaction-Mass Spectrometry (PTR-MS), High Performance Liquid Chromatography (HPLC) etc. The cryo-trapping method is very effective at trapping volatile organic compounds (VOCs) as most of the VOC boiling points are higher than the liquid nitrogen temperature (~77 K). However, handling of liquid nitrogen requires skilled person. Dry ice (solid CO_2) can be an alternative to liquid nitrogen for its easy handling procedure.

11.5 Preventive Measures to Control VOCs:

Air quality is one of the most important health indicators for both people and our planet. Air pollution is a complex issue that can be caused by many different factors. We have learned that VOCs play pivotal role in deciding the air quality.

The Air Quality Health Index (AQHI) is a great way to view air quality in our community and to understand how it can affect our health.

The AQHI measures the volume of pollutants in the air and provides a number that corresponds to how sensitive you are to those pollutant levels. It's based on standards set by the World Health Organization. Both the Government as well as person individual should take initiative to reduce the emission of VOCs.

Methods to lessen use and emissions of VOCs depend significantly on the specific process and product, but some methods include:

a. Tighten emission standards of motor vehicles and industries.

b. One should update and replace older heating units that run on propane or natural gas. While these fuels release fewer VOCs than oil, they still produce some harmful pollutants in the manufacturing process.

c. To control VOCs in indoor air emissions by choosing to purchase environmentally friendly cleaning products and supplies.

d. To store unused chemicals in a garage or shed. Chemicals should never be stored inside the house, where people spend much time.

e. To combat contaminated air (filled with VOCs), increase ventilation by opening doors and windows. Fans can be used to maximize air brought in from the outside which in turn will increase amount of fresh air in room.

f. To substitute commercially available paints with powder coating or UV-cured paint etc.

g. To use solvent-free or extremely low volatile solvents (ionic liquids, deep eutectic solvents, super critical CO2) to run chemical processes.

11.6 Conclusions:

Understanding how VOCs contribute to environmental pollution is important in order to create more sustainable cities for the growing urban populations. Cities are some of the most polluted places on Earth. In fact, one in eight deaths in cities is caused by air pollution. The problem is not limited to Asian and African megacities but is a global issue as more than half of the world's population live in urban areas. Air pollution is often a by-product of vehicle traffic, which has increased with the growth of urban populations and the advent of industry.

Therefore, it is important for city planners to be more conscious about how they can create sustainable solutions for transportation needs, which will ultimately reduce the burden on public health and help create healthier environments for everyone. Aggressive research programme is quite necessary to find sustainable tools or methods like production of user-friendly products with high thermal stability and low vapor pressure to fight against growing VOCs in earth ecosystem.

11.7 References:

1. Atkinson, R. (2000). Atmospheric chemistry of VOCs and NOX. *Atmos. Environ*. 34, 2063–2101. doi: 10.1016/S1352-2310(99)00460-4.
2. Carter, W. P. L. (1994). Development of ozone reactivity scales for volatile organic compounds. *Air Waste* 44, 881–899. doi: 10.1080/1073161X.1994.10467290.

3. Dzierzanowski, K., Popek, R., Gawronska, H., Sæbø, A., and Gawronski, S. W. (2011). Deposition of particulate matter of different size fractions on leaf surfaces and in waxes of urban forest species. *Int. J. Phytoremediation* 13, 1037–1046. doi: 10.1080/15226514.2011.552929.
4. Fasbender, L., Yáñez-Serrano, A. M., Kreuzwieser, J., Dubbert, D., and Werner, C. (2018). Real-time carbon allocation into biogenic volatile organic compounds (BVOCs) and respiratory carbon dioxide (CO2) traced by PTR-TOF-MS, 13CO2 laser spectroscopy and 13C-pyruvate labelling. *PLoS ONE* 13: e0204398. doi: 10.1371/journal.pone.0204398.
5. Guenther, A.B., Jiang, X., Heald, C.L., Sakulyanontvittaya, T., Duhl, T., Emmons, L. K., et al. (2012). The model of emissions of gases and aerosols from nature version 2.1 (MEGAN2.1): an extended and updated framework for modeling biogenic emissions. *Geosci. Model Dev.* 5, 1471–1492. doi: 10.5194/gmd-5-1471-2012.
6. Hebbert, M., and Webb, B. (2012). "Towards a liveable urban climate – lessons from Stuttgart," in *Liveable Cities: Urbanising World (ISOCARP 07)*, eds C. Gossop, and S. Nan (London; New York, NY: Routledge, 132–149 (Chapter 7).
7. Kansal, A. (2009). Sources and reactivity of NMHCs and VOCs in the atmosphere: a review. *J. Hazard. Mater*. 166, 17–26. doi: 10.1016/j.jhazmat.2008.11.048
8. Kesselmeier, J., and Staudt, M. (1999). Biogenic volatile organic compouds (VOC): an overview on emission, physiology, and ecology. *J. Atmos. Chem.* 33, 23–88. doi: 10.1023/A:1006127516791.
9. Calfapietra C, Fares S, Manes F, Morani A, Sgrigna G, Loreto F. Role of Biogenic Volatile Organic Compounds (BVOC) emitted by urban trees on ozone concentration in cities: a review. *Environ Pollut.* (2013); 183:71-80. doi: 10.1016/j.envpol.2013.03.012.
10. Berglund, B., Johansson, I., & Lindvall, T. (1989). Volatile organic compounds from used building materials in a simulated chamber study. *Environment International,* 15, 383-387. doi:10.1016/0160-4120(89)90052-4.
11. Reiss, R. et al. (1995). Measurement of organic acids, aldehydes, and ketones in residential environments and their relation to ozone. *J. Air Waste Manag. Assoc.*, 45 (10), 811-822, 10.1080/10473289.1995.10467411.
12. Koppmann, R. (2008) Volatile Organic Compounds in the Atmosphere. John Wiley & Sons

ISBN: 978-93-90847-02-0

12. Pristine Ganga Amid Covid-19

Dr. Shaveta Chauhan

Hans Raj Mahila Mahavidyalaya,
Jalandhar(Punjab).

Abstract:

The Ganges/Ganga is the third longest river of India after Indus and Brahamputra rivers. It embarks upon a journey of 2601 km originating in Gangotri glaciers of western Himalayas. This Himalayan River is the most pious river of Hindus who worshipped it as a goddess. It starts its journey from the hilly Garhwal region of Uttarakhand state and enter the plains at Haridwar.From Bijnor it enters into the India's most populated state of Uttar Pradesh covering almost 1450 km distance it enters third Indian state of Bihar at Ara and lastly into West Bengal near Rajmahal before entering Bangladesh and discharging its water into the Bay of Bengal. It not only serves as an economic and spiritual need of the civilians but also is home to many unique flora and fauna. The hydrological cycle in the Ganga basin is dependent on Southwest monsoon. Consequently, stream flow is considered seasonal in the river. This seasonality flow is responsible for both drought and floods in this area. The river is continuously changing course from the past time due to extensive human settlement in the area which keeps on causing havoc in this region regularly. Building of dams and barrages all across the river not only has obstructed the flow of water but also leads to severe water pollution which is posing danger not only to human health but also to fishes, amphibians, reptiles, birds and mammals who are living in it. Ganga is also known for its huge diversity of unique fauna. There are more than 140 species of fishes,90 species of amphibians,27 species of reptiles,315 sp. of birds and one critically endangered and endemic mammal in the south Asian river Dolphin (Platanista gangetica). Some other important animal species facing the verge of extinction and mentioned in Red Data Book which are found in its water are the golden mahaseer fish (Tor putitora), Gharial (Gavialis gangeticus), the northern river terrapin (Batagur baska), three stripped roofed turtle (Batagur dhongoka), red crowned roofed turtle (Batagur kachuga) and Indian skimmer (Rynchops albicollis). According to Central Pollution Control Board, at least 1072 industrial units directly discharge the waste laced with heavy metals and pesticides into the Ganga just between Haridwar and Kanpur. The first step taken by Govt. of India to make river pollution free was way back in 1986 by launching the Ganga Action plan. But it was considered as a huge failure due to many reasons like lack of proper planning and expertise,poor technology and technical support, corruption and lack of stringent laws of enforcement. The lockdown imposed on humans during pandemic COVID-19 has been proved as a boon for the environment. Nature is rejuvenating with air quality improving and rivers getting cleaner. This lockdown of almost 40 days has significantly affected Ganga also which is now looking shimmering and transparent at few areas as the pollution causing factories are shut down and human activities totally ceased. What could not be achieved in last 34 years and by spending 20,000 crores of rupees in Namami Ganga programme was visible in just 35-40 days of lockdown. Though Ganga didn't become pollution free but still 25-30 percent improvement in water quality was noticed.

This significant improvement in water quality parameters like low BOD and high DO, decrease in FCC (Fecal coliform count) clearly indicates that if government takes serious and adequate measures along with strict regulations imposed then in coming days even after the end of lockdown period what we have achieved will be maintained and more initiatives should be taken to make this pristine holy Ganga water fit for drinking again. The reviving of our rivers is not only the need of hour but also doable at the times when world is heading towards world war which is said to be fought for water in future.

12.1 Introduction:

There is no denial in the fact that water plays the most important role in every creature's life that is present on earth. Life on earth is possible owe to the presence of oxygen and water. Earth surfaces consist of 71% water out of which 96.5% is present in oceans which is unfit for drinking. 2.2% of fresh water available on earth surface out of 2.5% is locked in the form of snow in glaciers and at poles while only 0.3% is surface fresh water available for use by living beings is found in rivers and lakes.Water act as a fuel for performing the vital metabolic functions by all living creatures residing on this planet, Earth. Humans need water so that their bodies can function properly. The Panch-Tatva as mentioned in our Vedas are Air, water, fire, earth, and space are considered as the most important elements of life and therefore are considered sacred. They are worshipped with a universal deep feeling of honour in almost all faiths of the world.

Water is believed to be present in two forms:perishable and eternal. Human body consist of 60% water, and this is perishable form of it which disappears when a creature dies while the water recycling through hydrological cycle in nature is the eternal form of it. Water from rivers,lakes,seas and oceans keeps on evaporating continuously and comes back to earth in the form of rain and recharging again and again. Though composition of water varies in human being,an animal or a plant but its essence is same for all. Most religious beliefs the role of "holy" water whose purity is unmatched. The belief has its origin in the minds of people from pre historical time period and unknown mythological origins elevate its importance even further. This divine water is also used as a protection against evil .The use of this holy water known by various name in different faiths like Zamzam water (Muslims), Benitier(Roman catholics), Amrit jal(Sikhism), Mikvah/Mikveh(Jews), Pir-e-sabz(Zoroastrian) and Ganga Jal(Hinduism) for cleansing prior to a baptism and spiritual cleansing is also common.Even in present time of modernization water is still considered as a symbol of purity(both physical and spiritual), fertility and rebirth.

Development of human civilization is the most important role that rivers play. All ancient civilizations evolved around the river banks. The first human settlement occurs in river valleys like ancient Egyptians on the river Nile, Mesopotamia on the river Tigris/Euphrates, Ancient Chinese on the river Yellow and ancient India on the river Indus. Human settlements start appearing roughly around 12000 years ago on the banks of the major rivers.

This settlement around the rivers provides them with fresh water to drink,fertile land to sustain agriculture,fish for food,navigation and transportation also. It also provides a mean of defense and trade. After the wipe out of Harappan civilisation from Indus valley this centre shifted to Ganga valley.

Later the plains of Ganga withstand the test of time and became witness to the rise and fall of powerful states from Mauryan's to Mughal empire. These mighty emperors-built canals in the Gangetic plains for irrigation.

The Ganges canal was built by Britishers from 1842 to 1854 and it was formally inaugurated by Lord Dalhousie in 1854.

Figure 12.1: Goddess Ganga,Source: pinterest.com

In India, the importance of river Ganga is unmatched which occupies the highest place in the socio-cultural ethos of Indians. From times immemorial,the river Ganga is treated with great respect by Hindus. Legend says that King Bhagiratha of Ikshvaku dynasty bought the river Ganga from heaven on earth after doing rigorous penance for long time for the salvation of his deceased ancestors. The flow of Ganga was turbulent and huge due to which Lord Shiva locked her in his hair so that Ganga can safely land from heaven to earth.According to another legend related to Ganga is that Lord Vishnu during his incarnation of dwarf brahmin (Vamana avatar), he took three steps to cross the whole earth and universe and during his second step he accidentally placed a toe on the wall of universe where a hole appears and through which river Ganga comes out and thereby came to known as Vishnupadi. Ganga also found its mention in Mahabharata (Hindu epic) where it is described as mother of Bhishma and wife of King Sanatanu. The importance of Ganga water is mentioned in ancient Hindu scriptures(Puranas) where it has been described as sacred,having magical properties of cleansing all the sins of a person who takes a dip in its holy water and is bestowed with heavenly blessings.Hindus important pilgrimage site (Tirthas) like Gangotri, Haridwar, Prayagraj and Varanasi are situated on its banks. Hindus believe that these tirtha are crossing points between heaven and earth and by visiting these tirthas once in their lifetimes they will be descended to heaven after death.The Ganga is a synonym of faith, devotion and worship for Hindus.

Ganga is depicted as a mother Ganga,a beautiful woman riding the Makra (a creature with the head of a crocodile and the tail of a dolphin)(Figure12.1).Millions of Hindus worship considering her water very pure and believe that even bathing once in it will causes the remission of all their sins.People carry treasured holy and purifying Ganga water all across the country and world and keep it in a vial in their homes. The drop of this water is given to a dying person believing that it would provide him salvation.Ghats or flights of stairs are found all along the banks of Ganga at Varanasi(Uttar Pradesh) and Haridwar(Uttarakhand) where cremation of beloved dead ones and immersion of ashes is done to ensure their safe ride to the other world of their antecedents. Hindus believe that holy water of Ganga or Ganga jal not only purify soul but also liberate the soul from the cycle of life and death(reincarnation). Use of Ganga is pivotal in rituals and for puja (offerings to deities) which pronounce the perpetual nature of the river. During pilgrimage they take drops of Ganga jal in their mouth as they believed it to be the nectar of the Gods. The importance of Ganga and cities situated on its bank can be recognised from the fact that their mention has been found in accounts of Greek traveller and historian Megasthenes as early as 350-290BC. One could easily see the diversity of Indian culture by travelling along its course. Mark Twain's,an American writer quoted in 1890 "Benaras is older than history, older than tradition, older even than legend, and looks twice as old as all of them put together" says all about the importance of the river and towns situated on its banks since time immemorial(Figure12.3). Benaras is also considered sacred by Jain and Buddhist also. The Buddhist people of Thailand celebrates Log 'Krathong festival' to honor Gautama Buddha and Goddess Ganga. They float lit candles into waterways for good fortune and washing away their sins.

The jal(water) of Ganga not only used in rituals but it is also used to meet potable needs(secular role) of the residents through the city's water system. River not only provides sustenance to environment and ecology but also is a support system of 40% Indian population living along its bank and also to the diverse flora and fauna which is found in its water . The river basin is more than 1 million sq km with plains of Ganga as one of the most fertile tracts which accounts for about 47 per cent of the total irrigated area in India(Paul,2017). It also supports highest density of people in the world with 520 person/Km2 and a population of over 650 million people in three countries namely India, Nepal and Bangladesh.Nearly 80% of the Ganga River basin lies in India and the rest in Nepal and Bangladesh(Figure12.2). 43% of India's population lives in Ganga basin which accounts for 26 % of India's mainland.Ganga along with its tributaries form 30% of its water resources. If we consider its entire reach including all small tributaries of the Ganga River,then the basin comprises the parts of 11 states including 236 districts of India's national boundaries. Since ancient times it remains as a source of travel and communication also. The Ganga basin hosts a variety of fish species, including commercially important fishes such as Catla(Catla catla), Indian major carp, walking catfish(Claris batrachus), bronze featherback (Notopterus notopterus), Rohu (Labeo rohita), and golden mahaseer(Tor putitora), murrels etc. (Talwar and Jhingran,1991). 143 fresh water fish species reported out of which 10 are exotic fish species and 29 species were listed under threatened category along with critically endangered Ganges shark(Glyphis gangeticus)(Sarkar et al ,2012). The Gangetic plains are also home to wild Asian Elephants(Elephas maximus), Bengal tiger(Panthera t.tigris), Indian one horned rhinoceros(Rhinoceros unicornis), Sloth bear(Melursus ursinus), four horned antelope(Tetracerus quadicornis), Barasinghas (Rucervus duvauceili).

Bengal Tigers and saltwater crocodile(Crocodylus porosus) are only found in Sunderban delta. Large number of migratory birds are attracted to this region.Out of five true fresh water dolphins of the world,the Ganga River dolphin is one found in its water. The tropical moist decidious forest of Sal (Shorea robusta) are found in upper gangetic plains but due to human settlements and large-scale deforestation in this region only 3% of natural forests are left in this region.

Figure 12.2: The Ganges River course. Source:Maps of India.com

The Ganga is one of the third largest river of India after Indus and Brahmaputra. The Gangotri glacier one of the largest glacier of Himalayas with an elevation of 4000 m above sea level whose terminus resemble a cow's mouth known as Gomukh is the source of Bhagirathi River (tributary of Ganga) which along with river Alaknanda and Mandakini confluence at Devprayag and form sacred Ganga. After flowing speedily for 250 km in the mountains, it descends abruptly to an elevation of 288 m above mean sea level. It enters the plains at Hardiwar and take a long journey of 2,500 km by passing through the three Indian states namely Uttar Pradesh, Bihar and West Bengal before final merging in the sea of Bay of Bengal. The river is fed with melting water from snow of the Himalayan glaciers during April to June while from July to October River is recharged by the rains from South west monsoon. It is joined by various Himalayan rivers known as its tributaries like in upper Ganga basin Bhagirathi, Alaknanda, Ramganga, Ghaghara (largest tributary,1080 km) and Gomati while Yamuna, Tamsa, Sai, Sone, Gandak, Kosi and Damodar in the plains. The Ganga receives more than 60 per cent of its water from its tributaries. A large part of the snow melt water of the Ganga is diverted for irrigation (Upper Ganges Canal)as it enters the plains at Hardiwar. This cause a severe deterioration in its water flow till Kanpur from thereafter it is recharged by its tributaries mainly the Yamuna at Allahabad(Prayagraj). The purity of the water depends on its assimilative capacity and dilution flow of the river.

Most of the tributaries do not contribute much to its pollution load except the Gomati, Damador and Yamuna rivers.

Figure 12.3: Varanasi Ghats ;Source:economictimes.indiatimes.com

The river Ganga is a perennial source of water and plays a pivotal role in the growth of Indian civilization and economy. The river also provides avenues of income for the peoples living on its banks as the cities along the river attract large number of pilgrims and tourists throughout the year. The river is also used by adventure seekers for river rafting and water related sports at Rishikesh. The river Ganga ends at Bay of Bengal and forms the world largest delta. This delta complex is made up of 112 islands out of which only 48 are inhabited. Sunderban delta is home for some endemic, rare and threatened animals like Estuarine crocodile, water monitor, Gangetic dolphin, Olive Ridley turtle, Hawksbill turtle etc. and world's largest mangrove (*Heritiera fomes*) diversity also (Mitra and Zaman,2016; Mitra, 2019). The Maha Kumbh or Kumbh Mela,is the largest religious congregation of humans on earth and which is celebrated after every 12 years on the banks of river Ganga at Haridwar and at confluence of Ganga,Yamuna and invisible Saraswati rivers at Allahabad(Figure12.4&5). This importance and recognition for the Ganga is because people believe that Ganga water owes some naturally beneficial and self-healing properties. In 1972,Sir Seewoosagur Ramgoolam the then prime minister of Mauritius has taken away the holy Ganga water from Gaumukh and mixed it with the water of Grand Bassin in Mauritius renaming it as Ganga Talao for the Hindu population settled in Mauritius.

Figure 12.4&5: Mahakumbh at Allahabad(Source:ndtv.com & fortuneindia.com)

Popular folklore also points towards this unique and mystic properties of river Ganga. There are two major factors which makes Ganga water to qualify as unique. Firstly,it is the self-cleaning property of this river which do not allow water to deteriorate even after several years. The Ganga water is known to contain certain acteriophages(viruses which kill bacteria) due to which Ganga has unique antimicrobial properties. The bacteria's responsible for causing dysentry and cholera i.e Vibrio cholera are killed off naturally preventing its outbreak. The British bacteriologist, Ernest Hankin was pioneer in reporting about this amazing property of the Ganga water against *Vibrio cholera* in 1896 (Hankin,1896). These phages specific to bacterial species plays a key role in making Ganga water pious and non putrifying.

Three types of phages were isolated from Ganga water viz. *Escherichia coli, Salmonella typhii* and *Klebsiella pneumoniae*. This self-purificatory properties in Ganga water is due to its fluidity and presence of some unknown heat-labile peptides that kills the pathogenic *E.coli* (Nautiyal, 2009). It is found to have unusual regenerating capacity which brings down the level of BOD (Biological Oxygen Demand) very fast. Ganga is also found to have various species of bacteria's which excrete certain polymers which helps in removing turbidity of the water by acting as excellent coagulants. It can disintegrate organic waste 15-25 times faster in comparison to any other world's river.Owing so much importance the river gets its due finally and the river Ganga was declared 'The National River of India' in 2008 and the endemic Ganga Dolphin was declared as the 'National aquatic animal' in 2009. Secondly,it is the only river known for highest level of 12 ppm of oxygen and an ability to retain dissolved oxygen 25 times higher than any other river in the world but gradually it is losing this property of oxygen absorption and retention but today this ability has been reduced to 4-8 ppm.

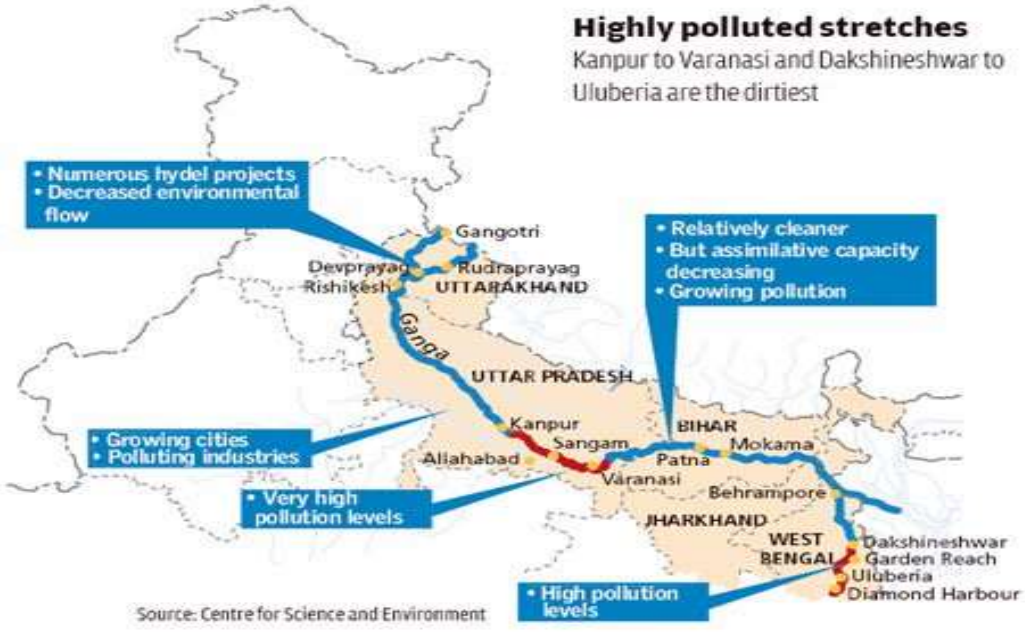


Figure 12.6: Source:Centre for Science and environment

12.2 Ganga Before Lockdown:

India is basically an agrarian country which is now considered as fastly developing country in the world due to its rapid development through urbanization and industrialization. A perennial source of water is a prerequisite for development of urban centres, agriculture, trade and industrialization and the river Ganga qualifies for the same.

Due to change in monsoon patterns and receding glaciers which are source of water to perennial river Ganga and over development in last three to four decades with many small towns situated on its banks have grown to become large cities has caused a havoc. Due to hilly terrain and unavailability of large chunks of flat land in the upper part of Ganga basin pace of industrialization remains comparatively slower in the state of Uttarakhand but at the foothills two major industrial towns are located i.e., Rishikesh to Haridwar known for their drug and heavy electrical industries. Gangetic plain is the most industrialized region of India. Uttar Pradesh is known as "Food Bowl of India" and degraded its 95% of natural vegetation in upper gangetic plain and replaced it with crops like sugarcane,wheat,paddy,chillies etc. Uttar Pradesh is also the highest sugarcane growing state of India and industries based on it like distilleries and sugar mills are mostly found in this region. High population growth and rising per capita income have encouraged farmers for crop diversification. Shift to more water requiring(water intensive) crops like sugarcane,paddy and wheat is putting more stress on both surface and ground water resources and depleting them very fast. The state of Uttar Pradesh in the Ganga River basin area has registered a tremendous increase in gross irrigated area of around 159% during the period of 1962-65 to 2003-2006 along with fertilizer consumption from 1.7 thousand tones per district to a level of 102.6 thousand tonnes during this period(Report by IIT,2011). Kanpur city known as leather city of the world with 80-90% of leather exports and Manchester of the east due to large number of textile industries situated here.Major cities like Patna and Kolkata, in the lower plains and Delta region,are also highly industrialized.

Though considered as the most sacred river the Ganga was unable to prevent its over-use, abuse and pollution. More than 80 per cent of the total pollution mainly comes from homes(domestic sources) along with religious offerings in form of food, leaves, flowers, ashes, bones, half burnt and uncremated bodies, caracasses of cow also contributing to the organic pollution load. Due to over-use of water for irrigation in the upper regions of the river along with the dry weather severely affects the flow of river Ganga. The anthropogenic human activities,changes in landscape and demographic movements have also an impact on river ecology and water quality(Figure12.6). During last few decades there is continuous occurrence of floods, natural disaster/calamities like landslides and cloud burst of 2013 has led to displacement of humans,loss of land, lives and livelihood along with internal migration in the river basin. River has repeated changing its course on its eastern bank(Farakka Barrage,West Bengal). The changing course of the river Ganga along with its tributaries are the source of constant natural disaster every year in the form of floods(in plains) tides and cyclones(in delta region). Both the tributaries of Ganga, the Kosi and Gandak in Bihar are known as 'Sorrow of Bihar' as they cause large havoc year after year during monsoons and changes physical boundaries between states of Bihar and Bengal. The Cyclones and floods are also prevalent in Sunderban area where new islands, streams and river channels keeps on appearing and disappearing. This leads to erosion and avulsion and though avulsion makes the land fertile, but erosion leads to loss of land.

An innumerable land disputes arise due to change in course of Ganga and its tributaries and such disputes are common between the residents of the area as well as between bordering neighbouring countries of Nepal and Bangladesh. During the last hundreds of years, the change in the course of Gandak (tributary of Ganga) known as Narayani in Nepal from east to west has led to border disputes between India and Nepal. Another tributary of Ganga, Tista after the floods of 1787 shifted westward and joined Brahamaputra. Ganga is continuously inclining towards east and Brahamaputra is shifting towards west.

Today, Ganga basin support one third of the country's civic population with 692 towns out of total 2300 located in this basin, and 100 are located along the river bank itself. Along the main river course there are 25 towns with a population of more than 100,000(class 1 cities) 23 towns with populations above 50,000(class 2 cities) and about 50 smaller towns with populations above 20,000(Paul,2017). The state of Uttar Pradesh has 1,000 km of the river's length with mostly all its major urban and heavily industrialized cities situated on its bank. It has 687 grossly polluting industries like that of tannery, textiles, sugar pulp and distillery plants, paper and chemical industries which are contributing 270 MLD of waste water or 70 per cent of the total waste water generated.Out of 100 big industries which are located directly on the river,68 of them are highly polluting. Fifty-five of these industrial units have installed effluent treatment plants (ETPs) and complied with the regulations. The region is also home to the most socio-economically drained(low-income) people who defecate in open on the banks. Taking holy dip or bathing along with other ritualistic practices further enhance its pollution level and put stress on the natural assimilative capacity of the river severely(Figure 12.7).

Figure 12.7: Polluted Ganga Source:indiatoday.in

The quality of water in a river is directly linked with human welfare. Due to its religious importance people take holy dip in its serine water throughout the year and this activity is maximum in summers at Har ki Pauri in Haridwar and Ghats of Varanasi. Though river is lifeline of half a billion people it also earns a status of one of the most endangered rivers of the world due to heavy pollution and poor water flow. Ganga is classified as among the ten world's most endangered rivers by WWF(World Wildlife Fund,2007). Heavy and recalcitrant toxic metals like Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel along with volatile and toxic organochlorate and organophosphate from pesticides,construction related debris also directly dumped into the river(Fig.8).

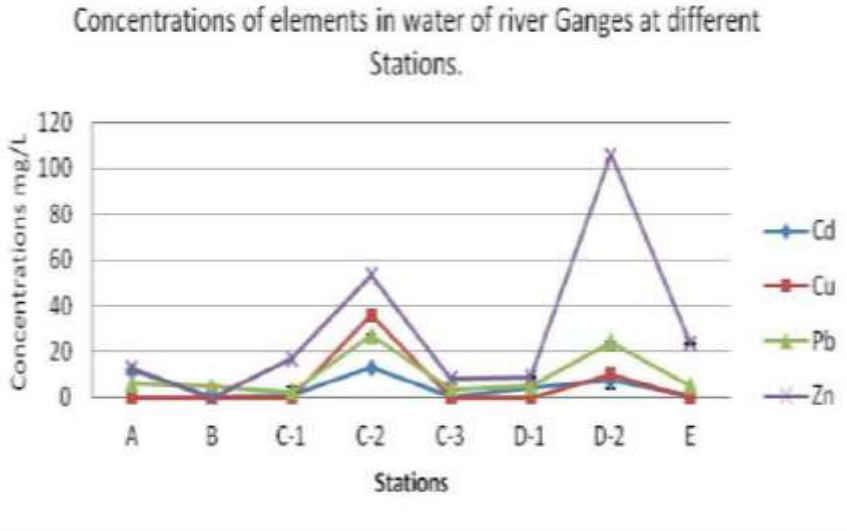


Figure 12.8: Source:researchgate.com

About 12, 222 million litres of domestic and 2500 MLD of industrial waste water which is generated daily is the major cause of pollution in Ganga basin. The Ganga enters U.P.in Bijnor district and passes through most populated and industrialized cities like Merrut, Bulandshahar, Aligarh, Kanpur, Allahabad and Varanasi. Throughout its stretch starting from U.P to West Bengal it violates the drinking water standards. 80% pollution comes from sewage flowing directly from towns and villages and rest 20% by industries. In the middle segment from Kannauj to Varanasi industries like metal industries, textiles, rubber, tannery, paints and pigments,varnishes, paper, steel plants , mining etc. add their effluents directly into the river. By the time river reaches the Kanpur more than 90% of its water is diverted for agriculture and river looks like a drain with concentrated toxic soup. Multipurpose river valley projects were regarded as "The temples of modern India" by Pt.Jawahar Lal Nehru, India's first prime minister considering them important for India's economic development. Dozens of hydroelectric power projects and dam construction started on river Ganga and its tributaries including important ones like Tehri project, Ramganga project, Gandak project, Kosi project, Bansagar, Matatila project, Damodar project etc. Activists and environmentalists claim as many as 940 dams,barrages and weirs are built on river Ganga and its tributaries leading to obstruction in the river's natural flow and blocking the river's arteries upstream. Infact construction of such dams proved to be fast tract destructive projects on our vulnerable river ecosystems.

The Gaumukh Gangotri glacier starting point of the Bhagirathi River which is believed to provide 70% of the river Ganga water in Uttarakhand is retreating 20 meters per year nearly twice as fast as twenty years ago. Intergovernmental Panel on Climate Change(2007) reported that Himalayan glaciers which feeds the river Ganga will disappear by 2035. Due to climate change,decline in rains is further weakening the flow. Huge cracks emerged on the glacier during the natural calamity of 2013 cloud burst which occurred in Uttarakhand. Heavy rains of 2016 have led to the collapse of large chunk of glacier and washing away of front end of Gomukh.Starting from the Bhagirathi upto the Hooghly in Kolkata there are large number of cottage industries running illegaly,dirty brick kilns and thermal power plants dumping out their waste directly into the river. Beside this illegal sand mining has removed away large chunks of sand from both banks and the riverbed. The iconic ghats of Varanasi and Haridwar,the toxic tanneries of Kanpur and north of Kolkata, are the highly polluted expanse of the Ganga. Kanpur is not only the largest city on banks of Ganga but is also a notorious hotspot for polluting its water. There are 442 tanneries in Kanpur contributing 8 per cent of the highly toxic and concentrated waste water. Leather and tanning industries situated here discharge 79 million gallons of effluent per day, exceeding the capacity of municipal treatment facilities(Figure12.9). The 404 units inspected by CPCB , only 23 were found in compliant with the laws of the country.Only 66% polluting industries in Kanpur established sensor-based real-time online effluent monitoring system on the order of Ministry of Water Resources (Del Bello, 2018). Drains discharging into river Ganga contributes BOD load of about 1000 tonnes per day. The sewage treatment plants are either of low capacity or are nonoperational due to lack of electricity or various other factors. According to CPCB(2013) report that 51 of the 64 sewage treatment plants (STPs) were underutilized by 60 per cent of their installed capacity and while 30 per cent were found unfunctional. Most cities along the Ganga do not have any sewage carrying systems. About 300 MLD of industrial effluents (9% of total waste water)is discharged directly into the river every day.

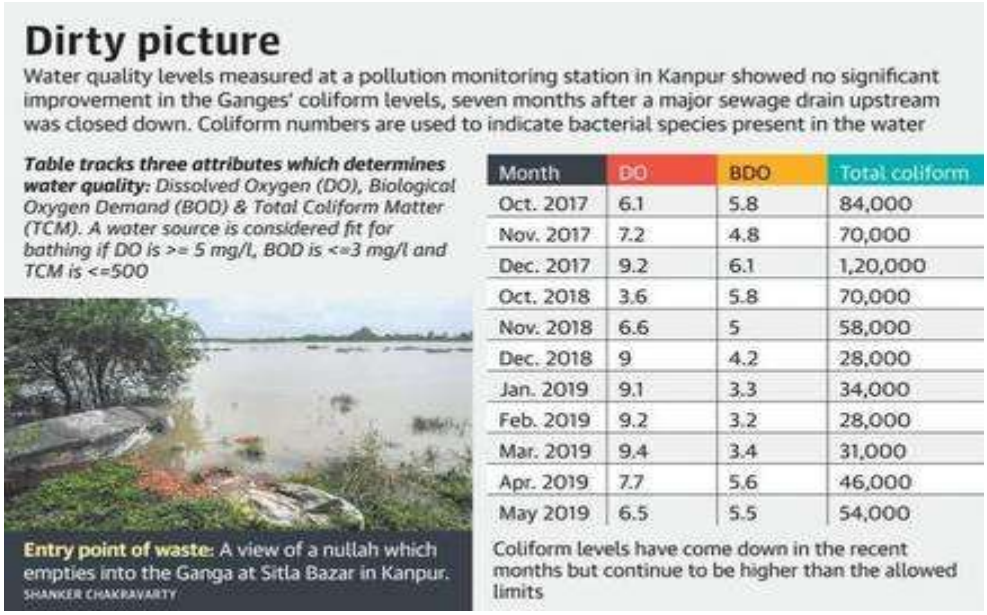


Figure 12.9: Source the Hindu,7.7.2019

The big and most populated cities like those of Kanpur, Allahabad and Varanasi does not have any underground drainage system.

They have open drains which are not connected to STPs and send 70 to 85 per cent of city sewage without any effluent treatment directly into the river. In Allahabad, the seventh most populated city of U.P 57 drains flow directly into the river.Over seven billion litres of raw sewerage are dumped into the Ganga every day from hundreds of big and small towns situated along the river and its tributaries.According to West Bengal Pollution Control Board the state of West Bengal contributes 48% almost half of waste water produced in the Ganga basin and only treats 42% of this .Untreated waste of about 1,779 million litres a day from the 54 drains directly fed into the river. The situation keeps on brimming day by day.Critically polluted points increased from 302 in 2016 to 315 stretches in 2018.Only 7 of 86 live monitoring stations had water fit for drinking after disinfection process and 18 spots out of 80 has water fit for bathing as assessed by CPCB(Central Pollution Control Board,2019). The spots which were found fit for drinking after disinfection(Class A) are Bhagirathi at Gangotri, Alaknanda at Rudraprayag and Devprayag,Raiwala and Rishikesh in Uttarakhand,Bijnor in Uttar Pradesh and Diamond Harbour in West Bengal. The spots which are marked in green indicates that water can be consumed only after disinfection at those places while it is highly polluted throughout its rest of the course and is even unfit for bathing till it drains into the Bay of Bengal(Figure12.10&11).

Figure 12.10, Source: Orissa Post 30.5.19 Ganga water unfit for drinking and bathing(CPCB)

Anthropogenic activities like cutting and cleaning of forests, illegal sand mining, hunting, discharge of heavy metals and lethal chemicals have made Ganga water unfit for drinking and even bathing. Once considered as “Braham Dravya” or divine elixir Ganga water has now become toxin acting like a poison,a noxious mix of heavy metals and chemicals. Groundwater is pumped out extensively for agriculture throughout the basin and recharging of it through water percolating from the river bed has declined significantly leading to drought like conditions now every year during summers. The waste generated by various large- and small-scale industries are directly dumping their waste into the river without any treatment by violating all laws leading to bio accumulation and bio magnifications. These metals accumulate in humans and animal bodies in very high doses leads to undesirable effects on human health.

The Ganga basin is fastly becoming an epicentre for various types of cancers in the country along with retardation in growth and development is also very common in children, various types of infections related to drinking contaminated water like hepatitis, dysentery, diarrhoea, typhoid, cholera, jaundice , skin infection etc. and even death. Water is found to be enriched with variety of strains of various bacterial group which have bactericidal characteristics. The contaminated river water is not only augumenting the risk of various disease but also nurturing the new strains of bacteria's which are antibiotic resistant. Studies done by the National Cancer Registry Programme showed that the regions which are lying downstream of the river course has the highest rate of Gall bladder cancer which is also stands second highest in the world. The other type of cancer which is most prevalent is the prostate cancer which is highest among the men of this part of the country. Besides this cancer of kidney, liver, urinary bladder and skin are also common here. Out of every 10,000 people,450 men and 1000 women were found to have Gall bladder cancer. Varanasi(Uttar Pradesh),Vaishali and Patna(Bihar), Murshidabad and South 24 Pargana(West Bengal) are the hot zones of cancer. Typhoid infection is also prevalent in this region.Over use of pesticides for crop protection in this area further aggravated the situation where these organochlorine rich chemicals lead to oesophageal and stomach cancers. There is 8.47 times higher risk of gall bladder carcinoma with infection from Typhoid(*Salmonella typhii*). Fecal Coliform Count in the Ganga water is at dangerously high level and increase the risk for various water borne diseases like Hepatitis,typhoid,cholera,amoebic dysentry and skin disorders. *S.typhii* isolated from Ganga water were found to possess virulence genes and are pathogenic for humans and animals.WHO(2012)reported that 115,000 people in India loss their life due to water and sanitation related problems. One out of every three deaths in India are related to water borne diseases and 80% of all illness is due to drinking of contaminated water. The world bank estimated that the health costs of water pollution in India is equal to 3% of its GDP.

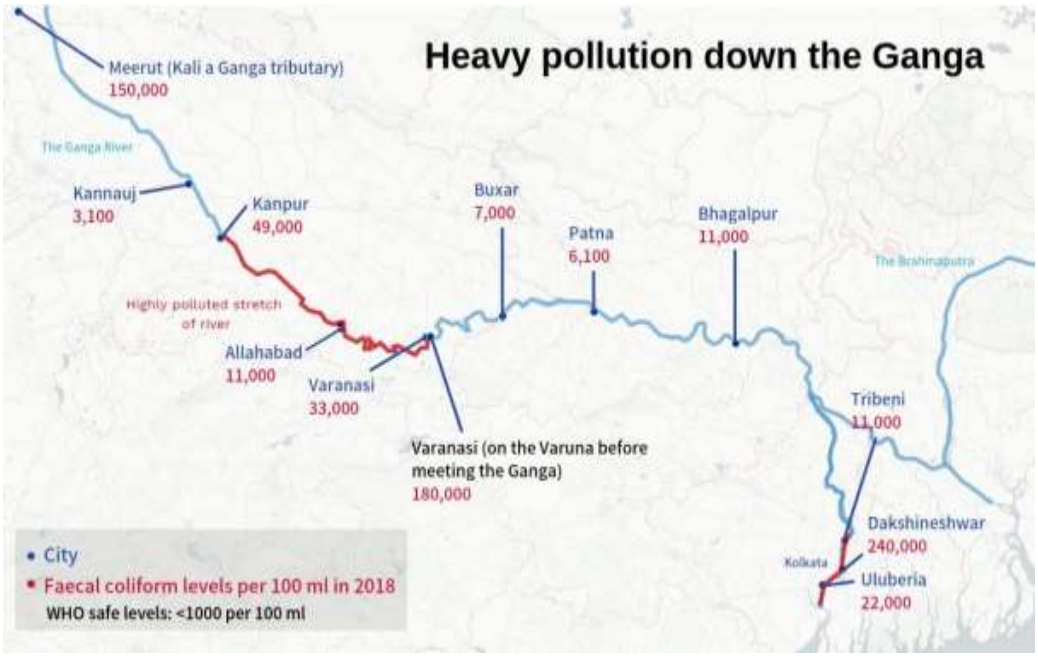


Figure 12.11, Source: thethirdpole.net

Water is considered fit for drinking and bathing according to CPCB standards if it has DO > than 6 mg/litre, BOD < than 2 mg/litre, Total coliform levels <than 5000/ 100 ml and pH should be in range of 6.5to 8.5. The CPCB(Central Pollution Control Board) continuously keep assessing the health of the water of river Ganga.Water quality assessment of the samples collected from Har Ki Pauri(Haridwar) and Ashram Ghat(Rishikesh) from 2007-2011 were found to be positive for *E.Coli* indicating fecal pollution of water.MPN(Most Probable Number) count for *E.Coli* was found to be maximum 450MPN/100ml at Haridwar and 170-230MPN/100ml water at Rishikesh.SPC(The Standard Plate Count) count too ranges from 320-450 SPC/ml×1000 at Haridwar and 150-240 SPC/ml×1000 at Rishikesh(CPCB,2012-2013)(Fig.12). The fecal coliform counts exceed the standard limit < 1000 per 100ml given by WHO.Various bacterias which are found in it includes *Staphylococcus aureus,Salmonella sp.,E.coli,Pseudomonas aeruginosa,Enterobacter aerogenes* and Shigella sp.(Nidhi et al 2015). The discharge of contaminated effluent directly into the river in absence of effective regulatory enforcement by the state pollution control board the water nowhere meets the drinking water quality standards(Figure12.11). The Faecal coliform level was 150,000 at Meerut,180,000 at Varanasi and 240,000 at Dakshineshwar(West Bengal).

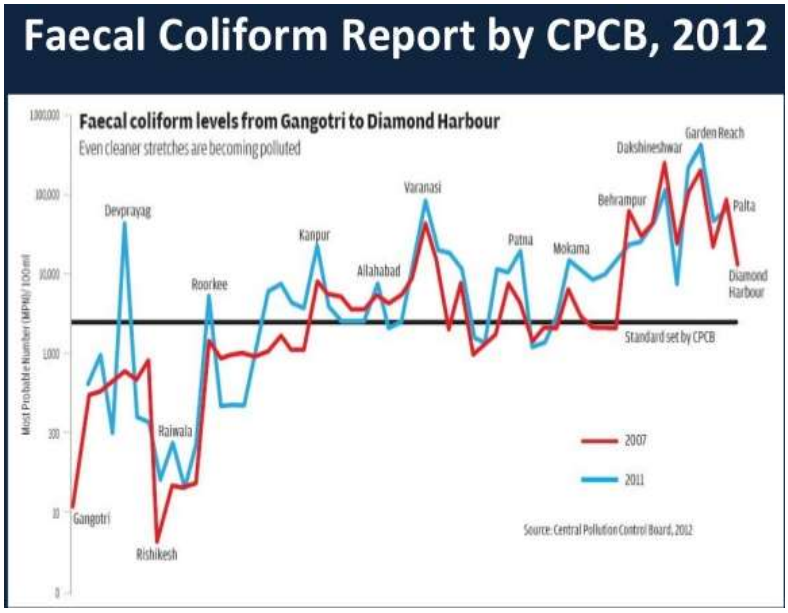


Figure 12.12, Source:slideshare.net

12.3 Ganga During Lockdown:

Rupees 4800 crores were spent on cleaning of Ganga starting from Ganga Action Plan(1986) till 2014. All the attempts failed in making Ganga pollution free whether it is Ganga Action Plan phase 1and 2 or the setting up of National Ganga River Basin Authority(2009). The present Government of India launched another 200 billion-rupee ($3 billion USD) National Mission for Clean Ganga (Namami Ganga Project, 2014) another latest attempt in a long line of failed attempts for not only making Ganga and its tributaries pollution free but also for their rejuvination and conservation. (Dwivedi *et al.,* 2018). World

Bank has also given a loan of $1billion along with Germany($120 million) and Japan (43.755 billion) for the same. The contamination is so high that once known for its crystal-clear water this Himalayan River converted into a cesspool.

The nationwide lockdown not only improved air and water quality but acted as a ventilator for our dying rivers. It seems like that "Coronavirus is Earth's vaccine to save it from human virus". CPCB, a body under the Ministry of Environment, Forest and Climate and Change, recently released a report on April 28,2020 which focused on the impact of the lockdown on the water quality of river Ganga. The report highlighted that due to a decrease in industrial activities and a decrease in domestic waste water, the quality of water in the river has improved. Lockdown leads to fall in pollution levels. The report explains that during the lockdown there is not only significant increase in DO value was but also reduction in nitrate concentration was also seen resulting in overall improvement in water quality of river Ganga. The report also suggested that the absence of industrial waste water discharge, agricultural runoff, and increased fresh flow has further augmented its quality. A decrease in the flow of domestic use of water from as many as 97 towns on the banks of the river has also resulted in an increase in the quality of water. During Lockdown industrial waste stopped entering the river due to their complete shut down along with curtailing of other human activities like tourism, bathing, washing,fairs,religious rituals etc. on ghats led to significant improvement in water quality. Though during this period, the amount of domestic sewage would have increased as people are staying at homes and maintaining hand-wash hygiene also. This improvement in water quality points to the fact that domestic sewage is not the only culprit responsible for deteriorating the quality of water. It has been observed that when sewage and industrial effluents are mixed together,the pollution gets assimilated, and it becomes difficult for river to self-rejuvenate. Another factor contributing to the dilution in pollution is the low level of pesticides running into river as the period was crop harvesting season.

Table 12.1 Source: Central Pollution Control Board (March 28, 2020)

Monitoring Station location	**BOD(mg/l)**	**DO(mg/l)**	**NH_3(mg/l)**	**COD(mg/l)**	**pH**
Ganga Barrage Upstream	2.1	8.0	0.49	<9.0	7.9
Ganga Barrage Downstream	1.21	7.9	1.1	<9.0	7.91
Shuklagunj	2.1	8.51	0.79	<9.0	7.68

According to CPCB data 27 points out of 36 real time water monitoring stations located at different localities on the Ganga River were found suitable for bathing during lockdown. The DO and BOD levels too show significant improvement at Kanpur and Varanasi of river where the DO level showed an increase from 6.5ppm to more than 8 ppm and BOD levels decreased from 4ppm to 3 ppm or even less then that (Table1,CPCB,2020) compared to its level at same time in 2019(Pathak and Mishra, 2020).According to CPCB polluted Nagwa Nala at Varanasi's show the DO value of 6.8mg/l remarkable increase from 3.8mg/l within a month (from 6 March-first week of April).

Ganga water at Haridwar and Rishikesh once again has become fit for 'achaman', which means ritual sipping, after decades showing an extraordinary improvement of 79% in its DO with 50% less sewage and industrial effluents were entering into it.

According to CPCB's on April 19 found that water from middle to lower stretches of Ganga such as Kannauj, Sangam at Allahabad (Table2), bathing ghats at Varanasi bathing ghat 1, Sukartal Ghat, barrage in Kanpur, Fatehpur bridge, Narora, Bhitpur, and Ganga nullah, Murshidabad and Howrah Bridge in West Bengal met the drinking water standards(BOD< 3 mg/l, DO >4 mg/l and pH 6 to 9).

Beside decrease in effluent discharge from factories and seize in human activities on the banks of the rivers like religious offerings, bathing, cremations etc. other natural factors which have contributed to enhancing the quality of the river water is the high and prolonged snowfall in upper reaches of Himalayas and above average rainfall from western disturbances in plains this year which consequently led to decrease in demand for irrigational water and also increased the river flow.

Researchers believe that due to less pollution load and more flow in the river enhance the self-purifying property of river Ganga which in consequence improved the quality of water by 40–50% making it fit for drinking during this lockdown (Hindustan Times, 2020,News18 Buzz, 2020)(Figure12.13).

Figure 12.13: Clean Ganga during lockdown.Source:downtoearth.org.in

The significant improvement in river water quality was also observed in the lower Gangetic delta also. The DO level was found to be significantly increased at Diamond Harbour by 38.54%, Namkhana by 31.73% and Ajmalmari by 12.4%(Sondipon *et al.*,2020). The maximum primary productivity is found in seas and oceans, and which depends on DO level. This increase in DO level in Gangetic delta will not only improve primary productivity but also secondary productivity(e.g Fishery). The lockdown also proved beneficial for the wild flora and fauna in river Ganga.After so many years, the endangered South Asian River Dolphin(Ganga Dolphin)was reported to be spotted by various people at different places of Uttar Pradesh, Bihar and Kolkata(Figure 12.14).

Figure 12.14, Ganga Dolphin spotted at Merrut. Source: IANS 27.4.2020

Table:12.2 Dip in Ganga Pollution at Sangam(Allahabad)

Date	BOD(mg/l)	Total coliform	Fecal coliform
March13	2.8mg/l	3400MPN/100ml	1300MPN/100ml
April 9	2.4mg/l	2600MPN/100ml	820MPN/100ml
April 30	2.3mg/l	2100MPN/100ml	680MPN/100ml

Source: Times of India,21.5.2020

12.4 Conclusion:

Fresh and clean water is vital for human endurance and rivers are precious sources of fresh drinking water for people across the world. The river Ganga is not just a legend but is the identity of 44% Indian population living on its banks.Global pandemic Covid-19 which started in Wuhan, an industrial hub in China and categorized as one of the beta cities of the world has infected more than 16.4 million people of world till date starting from its first report in December 2019. It has killed 630000 people in about 213 countries. Different countries imposed total lockdown ranging from 3-4 weeks to 2-3 months to check the spread of this infectious air borne tiny virus whose only vaccine is social distancing till time known. This lockdown has proved boon in disguise for the environment including all its spheres hydrosphere,lithosphere,atmosphere,and biosphere. Ozone hole started healing itself and so was the mother nature. During this lockdown environmental conditions(air, water) shown such an improvement which was believed to be unachievable for us even after spending crores of rupees just couple of months back. Though the pandemic sends economic shock waves across the globe. The global exports reduced by 4.6% and global GDP by 3.9%(World Bank). Air traffic was drop to 94.1% in April and still started with restrictions. The movement of goods,services and people all came to halt. The Covid-19 has created a feeling of uncertainity about returning to normal in minds of people. The pandemic hit hard the transport and travel industry along with tourism and electronics.

Even after lifting up of the lockdown trade still remains below 90% of its pre-crisis level. Global economic growth is trimmed by 3-6% which could only be partially recovered by 2021 and that too on assuming that there is going to be no second wave of infection in future.Global trade went down by 13-32% with millions of people losing their jobs. Poverty levels increased,careers derailed,mental sickness and depression increasing,social insecurity and unrest prevailing with more than 80 countries closing their borders, business closed, people staying indoors and even the centres of learning closed indefinitely. Several countries are in race of developing the first global Covid-19 vaccine. Different countries are adopting fiscal measures to provide support to different industrial, farm, health care sectors along with providing financial assistance to people of their country according to their ability. According to Global Alliance of Health and Pollution (Dec 2019)7 million people in the world and 2 million people in India die every year from air related problems(WHO, 2018).12.5% of deaths in India is due to air pollution. Among the top 10 polluted cities of world two are in India namely Delhi and Mumbai.WHO declared Covid-19 global pandemic on 11 March and most of the countries in the world imposed total lockdown. The quality of air improved in most polluted cities and dirty green or black coloured polluted water of rivers again become crystal clear fit for drinking and spotted with full of life. Wuhan,the birth place of Corona recorded cleanest February and March air quality during 10-week lockdown. Ten major global cities (Delhi, India; London, UK; LosAngeles,USA; Madrid, Spain; Mumbai, India; New York City, USA; Rome, Italy; Sao Paulo, Brazil; Seoul,South Korea and Wuhan,China) during 3-week lockdown from March23-April 13 show the reduction in PM2.5(Particulate Matter) from 25-60% as compared to the same time period in 2019 with Delhi, Mumbai and Wuhan showed the most. Air quality Index(AQI) improved in all major industrial cities of India(Table3)with Delhi showing improvement of 60-70%, Ahmedabad 37%, Kanpur60%, Talcher 52% and Visakhapatnam 42%.

Table:12.3 Air Quality March Second Week(before lockdown) to April 6(after lockdown)

City	PM 2.5(%drop)	Nitrogen Oxides(%drop)
Delhi	62%	50%
Ahemdabad	57%	32%
Mumbai	45%	60%
Pune	31%	62%

Source: Air Quality COVID Briefing India-GSCC

According to centre for research on energy and clean air on the very first day of lockdown i.e 25 March there was a decrease in PM2 .5 level by 22% and nitrogen dioxide by 15% due to the brakes applied on all modes of transportation which runs on petrol and diesel and on their combustion these harmful pollutants are released.The water of major polluted rivers of the world,river of Mekong(Thailand),the Amazon,the Congo,the Brahamputra,the Ganga during lockdown become fit for use again.According to Karnataka State Pollution Control Board the water quality of Cauvery river reached from C category to A category in this April.

The water of Vembanad lake the longest fresh water lake of India showed improvement in surface water quality. Yamuna Monitoring Committee reported reduction of 1-10% in pH,33-66% in EC(Electrical Conductivity), 51% in DO,45-90% in BOD and 33-82% in COD(Chemical Oxygen Demand) in Yamuna water at Nizamuddin bridge,Okha,Najafgarh drain and Shahdara drain during lockdown phase compared to pre lock down. Any disaster or calamity is considered as a challenge from God to test the human capacity to manage it through truthfulness and righteousness as described in our ancient Indian scriptures the Rigveda and Atharvaveda.

So is the challenge posed by Covid-19 for our policy makers and government to plan strategies and formulate mitigative measures as what we are not able to achieve in so many decades by launching so many projects for cleaner Ganga was achieved in lockdown period of 1-2 months.Keeping in mind the economic interests of a country and its people the lockdown cannot be imposed forever. Neither the industries can be shut down for infinite time nor the vehicular movement can be restricted.

The lesson we learn during this time is to become a more responsible and the uncontrolled and destructive human activities against nature responsible for degradation of environmental ecology and biodiversity must be curbed so that rivers like Ganga, Yamuna, Cauvery which were respiring on lockdown ventilator can be bought back to life. It is high time to restore the river's "**aviralta**" uninterrupted flow to insure its "**nirmalta**"(cleanliness). It is a known fact that when river changes it course it leads to the vanishing of the civilization. At present the lockdown imposed throughout the world to contain Corona virus spread has proven as a nature's vaccine to restore its ecosystem and environment. The environmental degradation which is caused by humans since the start of industrial revolution was reversed in a period of just 1–2 month.

This is a signal for us to understand the nature's call and be responsible in future. There is urgent need of controlling point sources of pollution along with enforcement of strict laws for environment protection not only in papers but also in realty. Public participation and technical advancement for the management and disposal of solid waste generated during agricultural practices and from homes is also need of an hour. The International Water Resource Management Institute has predicted that due to rapid industrialization and growth in population will lead to 32% increase in national water demand by 2050. It is high time to check pollution of surface water as well as groundwater along with proper implementation of water conservation measures otherwise it could lead to a Cape Town-like situation.

Indian cities already started facing such situation with Chennai the fourth largest urban city of India declared Day Zero on 19 June,2019. "**Pavan guroo,paanee pitaa maataa dharat mahat**"is a saying in Sri Guru Granth Sahib,the holy book of Sikhs that says Air is our guru(teacher), water our father, and great earth is our mother.

These resources are gift of God and God resides in them. If we harm them, we disrespect the almighty. We should consider them sacred. Secondly one should live in thankfulness and give due regards to the mother nature for its bounty of gift's which it bestowed on us . So it is not only the responsibility of the government but also of the people to act wisely and use these resources judiciously and sustain ably.

12.5 References:

1. CPCB. (2013). Pollution Assessment: River Ganga. Ministry of Environmental and Forests.
2. Del Bello, L. (2018). Indian scientists race to map Ganges River in 3D. Nature, 560(7717), 149-149.
3. Dwivedi, S., Mishra, S., Tripathi, R.D. (2018). Ganga water pollution: A potential health threat to inhabitants of Ganga basin. Environment International, 117, 327-338.
4. Hankin,E.H.(1896).L'action bactericide des eaux de la jumma et du Gange sur le vibrion du cholera.Ann Inst Pasteur,10,511-523.
5. HindustanTimes2020.Anxiety-more-time-to-study-for-40k-students-stranded-in-Kota.www.hindustantimes.com/india-news/anxiety-more-time-to-study-for-40k-students-stranded-in-kota/story-LgCluBkrFEITG9qyX16IEI.html Retrieved from: [Google Scholar]
6. Mitra,A.2019.Estuarine Pollution in the lower gangetic delta.Published by Springer International publishing.ISBN 978-3-319-93305-4,XVI,371.
7. Mitra,A and Zaman,S.(2016).Basics of Marine and Estuarine Ecology.Published by Springer International publishing.ISBN 978-81-322-2707-6.
8. Nautiyal, C. (2009). Self-purificatory Ganga water facilitates death of pathogenic *Escherichia coli* O157: H7. Current microbiology, 58(1),25-29.
9. Nidhi Singh Chauhan,Manjul Dhiman(2015).Assessment of microbial diversity of river Ganga at Haridwar and Rishikesh.International Journal of Scientific Research, 4(11),393-396.
10. News18 Buzz.(2020).Ganga River Water Has Now Become Fit for Drinking as Industries Remain Shut Due to Lockdown. https://www.news18.com/news/buzz/ganga-river-water-has-now-become-fit-for-drinking-as-industries-remain-shut-due-to-lockdown-2575507.html Retrieved from: [Google Scholar]
11. Paul, D.(2017).Research on heavy metal pollution of river Ganga: A review. Annals of Agrarian Science. 15(2),278-286.
12. Pathak, S.S., Mishra, P.(2020). A review of the Ganga River water pollution along major urban centres in the state of Uttar Pradesh, India. Int. Res. J. Eng. Technol. 7(3):1202–1210. [Google Scholar]
13. Sarkar,U.K., A.K.Pathak,A.K.Pandian,A.Pandey, V.K.Dubey, and W.S.Lakra.(2012). Freshwater fish biodiversity in the river Ganga(India):changing pattern,threats and conservation perspectives:Rev Fish Biol.Fisheries.22:251-272
14. Sondipon Chakraborty, Ankita Mitra, Prosenjit Pramanick, Sufia Zaman and Abhijit Mitra.(2020). Scanning the water quality of lower Gangetic delta during COVID-19 lockdown phase using Dissolved Oxygen(DO) as proxy. NUJS Journal of Regulatory Studies, Special Edition, pp 61-66.
15. Talwar,P.K. and A.G.Jhingran(1991).Inland fishes of India and adjacent countries. Volume1& 2A. Oxford and IBH Publishing Co.Pvt.Ltd, New Delhi.

ISBN: 978-93-90847-02-0

13. उपभोक्ता आन्दोलन – एक ऐतिहासिक अवलोकन

डॉ. राजेश मौर्य

सहा. प्रा. अर्थशास्त्र,
शास. नेहरू महा. वि. सबलगढ़,
जिला–मुरैना.

प्रो. जे. पी. मित्तल

प्राचार्य,
शास. नेहरू महा. वि. सबलगढ़,
जिला–मुरैना.

प्रस्तावना :–

भारतीय उपभोक्ता के संदर्भ में भारत के महापुरूष तथा महान स्वतंत्रता सैनानी **महात्मा गॉधी जी ने कहा था कि –** "एक उपभोक्ता या ग्राहक हमारे परिवार में एक महत्वपूर्ण आगुॅतक हैं, वह हम पर निर्भर नहीं हैं, हम उस पर निर्भर हैं, वह हमारे काम में बाधा नहीं हैं, वह उसका उद्देश्य हैं, वह हमारे व्यवसाय में कोई बाहरी व्यक्ति नहीं हैं, वह उसका हिस्सा हैं, हम उसकी सेवा करके उस पर एहसान नहीं कर रहे हैं, वह हमें ऐसा करने का अवसर देकर हमें कृतज्ञ कर रहा हैं **– "महात्मा गॉधी जी।**

किसी भी देश की अर्थव्यवस्था में बाजार एक मुख्य कारक होता हैं। साधारण शब्दों में बाजार उसे कहा जाता हैं, जहॉ व्यापक स्तर पर क्रेता तथा विक्रेता पाये जाते हैं। यहॉ क्रेता को उपभोक्ता भी कहा जाता हैं। जिसमें आम जनता से लेकर आम, हम या देश के समस्त नागरिक शामिल होते हैं, जबकि विक्रेता दुकानदार या उत्पादक होता हैं, जो हमेशा बाजार में अपनी वस्तुओं तथा सेवाओं को बेचने के लिये तत्पर रहता हैं। जब आप या हम लोगों को किसी भी वस्तु या सेवा की आवश्यकता होती हैं, तो विक्रेता से उन्हें (वस्तु या सेवा) खरीदकर प्राप्त करते हैं, परन्तु विक्रेता या उत्पादक अधिक लाभ अर्जित करने के लिये उपभोक्ता के साथ धोखा करता हैं अर्थात वजन, माप से लेकर मिलावट तक उपभोक्ता के सामने पेश करता हैं। ये ऐसी वस्तुऐं एवं सेवाऐं होती हैं, जो घटिया, निम्न स्तर की तथा गुणवत्ताहीन होती हैं। इस प्रकार उत्पादक या दुकानदार ग्राहक या उपभोक्त के साथ धोखाधड़ी करके उसके साथ अन्याय करता हैं। इसी अन्याय के खिलाफ उपभोक्ता अपनी आवाज उठाने के लिये उपभोक्ता आन्दोलन का सहारा लेता हैं। यदि यह कहा जाये कि उपभोक्ता आन्दोलन का प्रार्दुभाव उपभोक्ता के शोषण या अन्याय के परिणामस्वरूप हुआ हैं, तो इसमें कोई आतिश्यौक्ति नहीं होगी।

उपभोक्ता आन्दोलन एक प्रकार से घटिया, निम्न स्तर की तथा गुणवत्ताहीन वस्तुओं एवं सेवाओं के खिलाफ लोगों द्वारा उठायी गयी एक आवाज हैं, जिसमें एक या एक से अधिक उपभोक्ता

एकत्रित होकर सामूहिक रूप से उसका (दुकानदार, उत्पादक) विरोध करते हैं। यह समस्या (उपभोक्ता आन्दोलन) न केवल भारत की हैं, बल्कि विश्व के कई अन्य देशों जैसेः– थाइलैंण्ड, श्रीलंका, चीन, ताइवान, नेपाल, इण्डोनेशिया आदि में भी उत्पन्न हुयी हैं।

उपभोक्ता आन्दोलन के प्रार्दुभाव के बारे में ऐतिहासिक स्त्रोतों में एक प्रकार का विरोधाभाष हैं। **गैल ब्लुबर्ड (Gayle Bluebird) ने अपने लेख ''उपभोक्ता आन्दोलन का इतिहास'' में यह उल्लेख किया हैं कि –** ''विश्व में सर्वप्रथम उपभोक्ता आन्दोलन की शुरूआत क्लिफोर्ड बीयर्स (Clifford Beers) द्वारा लिखी गयी पुस्तक **''ए माइंड दैट फाउंड इटसेल्फ''**,जो कि सन 1908 में प्रकाशित हुयी थी, के परिणामस्वरूप हुयी हैं।[1] जिसने आगे जाकर अमेरिका में मैन्टल हैल्थ एसोसियेशन की स्थापना में अपना पूर्ण योगदान दिया था, जबकि भारत में इसकी शुरूआत **सन 1915 में मुम्बई में यातायात तथा यात्रियों की राहत संघ स्थापना के साथ हुयी थी।**[2]

यह शोध पत्र पूर्ण रूप से उपभोक्ता आन्दोलन की ऐतिहासिक पृष्ठभूमि पर आधारित हैं। जिसमें हम सम्पूर्ण विश्व में उपभोक्ता आन्दोलन की शुरूआत, कारण, संरक्षण उपायों, कानूनों व अधिनियमों आदि पर विस्तारपूर्वक दृष्टि डालेगें।

13.1 उपभोक्ता आन्दोलन क्या हैं? :–

सामान्य रूप से यह शब्द दो शब्दों उपभोक्ता+आन्दोलन से मिलकर बना हैं। यहॉ उपभोक्ता का मतलब वह व्यक्ति, जो दुकानदारों तथा उत्पादको से वस्तुऐं व सेवाऐं क्रय करके अपनी संतुष्टि (उपयोगिता) प्राप्त करता हैं, जबकि आन्दोलन का आशय किसी भी शोषण या अत्याचार के खिलाफ लोगों या उपभोक्ताओं के समूह द्वारा उठायी गयी एक आवाज हैं। इस प्रकार उपभोक्ता आन्दोलन का अभिप्राय हुआ – वह दुकानदारों या उत्पादकों के खिलाफ उठ खड़े होना, जो मिलावट युक्त, घटिया या निम्न स्तर एवं गुणवत्ताहीन वस्तुओं व सेवाओं का विक्रय करता हैं, उपभोक्ता आन्दोलन कहा जाता हैं।

उपभोक्तावाद की अवधारणा ठीक उसी प्रकार से हैं, जिस प्रकार लेकतंत्र की अवधारणा प्रचलित हैं अर्थात उपभोक्ताओं का, उपभोक्ताओं के लिये, उपभोक्ताओं द्वारा, इसी तरह से आधुनिक युग में उपभोक्तवाद (उपभोक्ता आन्दोलन) को पहचाना जाता हैं।

वर्तमान में जिस प्रकार समस्त विश्व की अर्थव्यवस्थाऐं एकीकृत होकर वैश्वीकरण के युग में प्रवेश कर रही हैं, वैसे–वैसे बाजार का आकार वैश्वीकृत अर्थव्यवस्था के समान आगे बढ़ता जा रहा हैं, इसीलिये उपभोक्ता को बाजार में राजा की संज्ञा दी गयी हैं। आज की अर्थव्यवस्था जो कि प्रगतिशील अर्थव्यवस्था की ओर अग्रसर हो रही हैं, उसे ध्यान में रखते हुये उपभोक्ता को विशेष महत्व दिया जा रहा हैं और उसे संतुष्ट करने के हर संभव प्रयास किये जा रहे हैं, परन्तु व्यावहारिक रूप से वास्तविकता कोसो दूर हैं, दरअसल इस वैश्विक युग में कई प्रकार से उपभोक्ताओं को भ्रमित किया जा रहा हैं। जब से ऑनलाईन खरीदारी का प्रचलन हुआ हैं, तब से वह धोखा या शोषण का शिकार होता आ रहा हैं। विज्ञापन के दौरान, जिसे हम टी. व्ही. (TV) पर देखते हैं और कुछ (बेहत्तर गुणवत्ता) होता हैं, लेकिन जब वह हमारे पास आती

हैं, तो उसकी गुणवत्ता बेहद कम या निम्न होती हैं अर्थात हम कह सकते हैं कि आज भी किसी न किसी रूप में उपभोक्ता के साथ धोखा किया जा रहा हैं।

उपभोक्ता आन्दोलन एक प्रकार से किसी भी वस्तु या सेवा क्रय करने के संबंध में दुकानदारों या उत्पादकों द्वारा धोखाधड़ी या शोषित करने के परिणामस्वरूप उनके (उपभोक्ताओं) हितों एवं अधिकारों को सुरक्षा प्रदान करने की दृष्टि से आरंभ किया गया एक अभियान हैं।

फिलिप कोटलर तथा आर. जी. आर्मस्ट्रॉग के अनुसार – "उपभोक्तावाद विक्रेताओं के संबंध में खरीदारों के अधिकारों तथा शक्तिओं को लागू करने के लिये नागरिकों एवं सरकारों का एक संगठित आन्दोलन हैं।"[3]

क्रेवेन्स एण्ड हिल्स के अनुसार – "उपभोक्तावाद पर्यावरण के भीतर एक सामाजिक शक्ति हैं। जिसे व्यवसाय पर कानूनी, नैतिक और आर्थिक दवाब डालकर उपभोक्ता की सहायता और सुरक्षा के लिये बनाया गया हैं।"[4]

उपभोक्ता विश्लेषण के आधार पर कहा जा सकता हैं कि उपभोक्ता आन्दोलन एक प्रकार से दुकानदारों या उत्पादकों द्वारा उपभोक्ताओं के साथ धोखाधड़ी या शोषण के खिलाफ लोगों या उपभोक्ताओं के समूह द्वारा उठायी गयी एक आवाज हैं। जिससे उनके हित व अधिकार सुरक्षित रह सके। यह आन्दोलन उन्हें (उपभोक्ताओं) एक सामाजिक शक्ति प्रदान करके दुकानदारों एवं उत्पादकों के खिलाफ लड़ने की शक्ति प्रदान करता हैं।

13.2 ऐतिहासिक पृष्ठभूमि :–

हालॉकि यह माना जाता हैं कि उपभोक्ता आन्दोलन की शुरूआत उस समय हुयी थी, जब क्लिफोर्ड बीयर्स की पुस्तक **ऐ माइंड देट फाउंड इटसेल्फ, सन 1908 में प्रकाशित हुयी थी,** परन्तु यह प्रमाण उचित नहीं हैं, क्योंकि उपभोक्ता आन्दोलन के ऐतिहासिक दस्तावेजों के स्त्रोतों से यह पता चलता हैं कि विश्व में उपभोक्ता आन्दोलन की ये घटनाऐं काफी प्राचीन तथा सदियों पुरानी हैं। ऐसे कई उदाहरण या प्रमाण हैं, जैसेः– मैसाचुसेटस में पारित किया गया पहला उपभोक्ता कानून 1784 और यही पर सन 1990 में वजन व माप से संबंधित कानून, यूनाइटेड किंगडम में सन 1852 का मर्चेडाइज मार्क्स कानून, वजन व माप से संबंधित यू. के. में 1878 का अधिनियम तथा सन 1893 में लागू किया गया माल एवं बिक्री संबंधी कानून आदि ये सभी कानून या अधिनियम इस बात की पुष्टि करते हैं कि उपभोक्ता आन्दोलन संबंधी विचार की अवधारणा बहुत पुरानी हैं अर्थात 16वीं व 17वीं शताब्दी से आरंभ होकर धीरे–धीरे 19वीं शताब्दी तक अपने चरमोत्कर्ष पर पहुॅच गयी थी। इसी श्रृॅखला में 19वीं शताब्दी में इंग्लैण्ड में एक घटना घटित हुयी थी कि कपड़ा उद्योग में काम करने वाले श्रमिकों ने संगठित होकर कार्य की दशाओं के संबंध में कपड़ा मिल मालिक के खिलाफ विरोध उत्पन्न कर दिया था। इसी प्रकार का एक ओर आन्दोलन, जो कि इंग्लैण्ड की महिला श्रमिकों के संबंध में था, गुलामी की तरह कार्य करवाने के खिलाफ हुआ था।

19वीं शताब्दी के अंत तक उपभोक्ता आन्दोलन की आग अमेरिका, यूरोप तथा यूनाइटेड किंगडम तक फैल चुकी थी। इन देशों के उपभोक्ताओं ने बिचौलियों तथा मुनाफा खोरी से बचने के लिये क्लब स्थापित करने के छुटफुट प्रयास भी किये थे। ये क्लब एक प्रकार से

भारत में स्थापित सहकारी समितियों की तरह थे। जहॉ सीधे माल उत्पादकों से खरीदा जाता था और उत्पादक द्वारा यह प्रमाण दिया जाता था कि उक्त सामग्राी (माल) मिलावट युक्त, घटिया या गुणवत्ताहीन नहीं हैं। ये क्लब आज भी संचालित हैं तथा अपने जोश–खरोस के साथ कार्य कर रहे हैं।

भारत के संदर्भ में भी उपभोक्ता आन्दोलन की शुरूआत को लेकर लेखकों में भ्रम हैं। यहॉ उपभोक्ता आन्दोलन की शुरूआत सन 1915 से मानी जाती हैं, जबकि प्राचीन भारतीय ऐतिहासिक स्त्रोत बताते हैं कि उपभोक्ता आन्दोलन की शुरूआत लगभग 200 ईसा पूर्व में की गयी थी। उस समय खाद्यय पदार्थो में मिलावट के खिलाफ कानून थे।

विश्व में उपभोक्ता आन्दोलन की शुरूआत कैसे हुयी तथा इसके कारण क्या थे? आदि को समझने के लिये इसे तीन भागों में विभाजित किया गया हैं।

1. **उपभोक्ता आन्दोलन का पहला चरण :–** जैसा कि हम पूव में जान चुके हैं कि विश्व में सर्वप्रथम उपभोक्ता आन्दोलन की शुरूआत संयुक्त राज्य अमेरिका में हुयी थी। इस देश में उपभोक्ता आन्दोलन की शुरूआत में दो नकारात्मक पहलुओं ने योगदान दिया था। पहला – बाजारों में उचित मात्रा में प्रतिस्पर्धा हासिल करना तथा दूसरा – नवीन उत्पादों की सुरक्षा व गुणवत्ता बनाये रखना। इसमें वे सभी उत्पाद शामिल थे, जो न केवल स्थानीय स्तर पर बल्कि राष्ट्रीय स्तर पर बेचे जा रहे थे, हालॉकि यह सत्य हैं कि उस समय अमेरिका में अधिकॉश निर्माता या उत्पादक गुणवत्तापूर्ण वस्तुओं व सेवाओं के निर्माण में संलग्न थे, परन्तु फिर भी कुछ उत्पादक थे, जो उपभोक्ताओं के हितों की अवहेलना कर रहे थे, इसलिये उनके अधिकारो व हितो की रक्षा के लिये पहली बार **सन 1856 में एक चयन समिति की स्थापना की गयी थी, जिसने अपनी सिफारिशों में कहा कि झूठा या मिलावट युक्त भोजन उपभोक्ता के साथ किया गया अन्याय हैं।**[5] उस समय अमेरिका में ट्रस्ट सहित कई अन्य 12 संगठन स्थापित किये गये थे। इसी श्रॅृखला में सन 1865 में ऐसे रोगग्रस्त मवेशियों व सूअरों के आयात पर प्रतिबंध लगाने के लिये एक संघीय कानून पारित किया गया था। **सन 1848 में अमेरिका में ऐसे उत्पादकों तथा निर्माताओं के खिलाफ, जो नकली दवाओं से लेकर दूषित भोज्य सामग्री व विघटित दवाओं के विक्रय में संलग्न थे, आयात औषधि अधिनियम पारित किया गया था।**[6] इसके अलावा सन 1887 में अन्तर राज्यीय वाणिज्य आयोग (रेल, सड़क उद्योग को विनियमित), 1894 संघीय व्यापार आयोग आदि स्थापित किये गये थे।

   उपभोक्ता आन्दोलन के प्रथम चरण के अन्तर्गत संयुक्त राज्य अमेरिका में जिन कानूनों की स्थापना की गयी थी। उनमें डॉ. हार्वेवी डब्ल्यु बिली का महत्वपूर्ण योगदान रहा हैं। वे 1883 तक अमेरिका में ही कृषि विभाग के प्रमुख थे। उन्होंने अनेक ट्रस्टों एवं संघों की स्थापना में अपना अमूल्य सहयोग दिया था। नेशनल उपभोक्ता लीग, जिसका मुख्य उद्देश्य महिलाओं की कामकाजी परिस्थितियों में सुधार करना था, में भी उनका अहम योगदान रहा था।
2. **उपभोक्ता आन्दोलन का द्वितीय चरण :–** संयुक्त राज्य अमेरिका में जो पहला चरण संचालित था, वह 1910 के दशक में समाप्त हो गया था। सन 1910 से 1920 तक की अवधि में इस आन्दोलन का दूसरा चरण आरंभ हुआ था, जो कि औद्योगिक क्रॉति के परिणामस्वरूप व्यापक स्तर पर संचालित हुआ था। इस चरण में उपभोक्ता अनुसंधान इंक

नामक संगठन अमेरिकी सरकार के वित्तीय सहयोग से स्थापित किया गया था। यह (संगठन) जैसे ही स्थापित हुआ, वैसे ही इसने उत्पादों को निरीक्षण एवं जॉच करने के लिये प्रचार–प्रसार आरंभ कर दिया था। इस अवधि में जो भी संघ या संगठन स्थापित किये गये थे, उसकी महत्वपूर्ण विशेषता यह थी कि उक्त सभी का गठन संघीय सरकार के सहयोग से हुआ था। उपभोक्ता सलाहकार बोर्ड, उपभोक्ता परिषद (कृषि विभाग के अन्दर), खाद्य एवं नशीली दवाओं से संबंधित कानून, फेडरल फुड एण्ड ड्रग्स कानून 1938, फेडरल व्यापार आयोग कानून 1914 आदि। **सन 1938 में जो फेडरल फुड एण्ड ड्रग्स कानून पारित किया गया था, उसमें एक संशोधन करके फेडरल व्यापार आयोग को शामिल करते हुये अनुचित व्यापार या भ्रामक प्रथाओं के खिलाफ निर्णय देने का अधिकार प्रदान किया गया था।**[7]

3. **उपभोक्ता आन्दोलन का तीसरा चरण :–** उपभोक्ता आन्दोलन का तीसरा चरण काफी मुश्किलो एवं कठिनाईयों से भरा हुआ था। द्वितीय विश्व युद्ध, उपभोक्ताओं की वस्तुओं एवं सेवाओं की कीमतों में वृद्धि, व्यापक स्तर पर मुद्रास्फीति आदि समस्याऐं उत्पन्न हो गयी थी। सन 1946 से 1956 के बीच की अवधि में जो मुद्रा स्फीति उत्पन्न हुयी थी, उसने उपभोक्ताओं को तकनीकी एवं जटिल रूप से उत्पादित उत्पादों की ओर रूख करने के लिये मजबूर किया था।

   इस चरण में जो उपभोक्ता आन्दोलन संचालित हुआ था, उसमें एक अमेरिकी नागरिक **राल्फ नादर** का मुख्य योगदान रहा था, जिसे बाद में उपभोक्ता आन्दोलन का एक निर्विवाद नेता घोषित किया गया था, क्योंकि उन्होंने वर्षो से चल रहा जनरल मोटर्स ऑटो मोबाइल्स का अदालत संबंधी मुकदमा हम करने में अपनी मुख्य भूमिका अदा की थी, हालॉकि इसके लिये उन्होंने अनेक संकटों का सामना किया था, जैसेः– राल्फ नादर ने इस कार कंपनी की जासूसी आरंभ की तो उन पर हमला हुआ था और चोट भी आयी थी, परन्तु फिर भी उन्होंने अपने गुरिल्ला जासूसी ऑपरेशन के जरिये सबूत एकत्रित किये और उसे हम करने में सहयोग दिया था। इसके बाद राल्फ नादर ने अमेरिका में पारित किये गये उपभोक्ता आन्दोलन से संबंधित कानूनों व अधिनियमों पर धावा बोला, उनका दावा था कि जब यह मामला हुआ तक संघीय व्यापक आयोग, खाद्य एवं औषधि प्रशासन कानून, अर्न्तराष्ट्रीय वाणिज्य आयोग आदि कानूनों एवं अधिनियमों ने निगरानी व निरीक्षण क्यों नहीं किया, क्या वे इस घटना के समय सो गये थे – यही ऐसे कारण थे, जिसकी वजह से राल्फ नादर को उपभोक्ता आन्दोलन का एक मुख्य नेता माना जाता हैं। इसके बाद अमेरिकी राष्ट्रपति **जॉन केनेडी ने 15 मार्च, 1962 में उपभोक्ता आन्दोलन के संबंध में एक संदेश दिया, जिसमें उन्होंने 4 बुनियादी उपभोक्ता अधिकारों की बात की, जिसे बाद में द कंज्यूमर बिल ऑफ राईटस कहा गया था।**[8] उनके इस संदेश ने उपभोक्ता आन्दोलन के तीसरे चरण को एक गति प्रदान की थी।

13.3 भारत में उपभोक्ता आन्दोलन :–

भारतीय ऐतिहासिक स्त्रोतों से यह पता चलता हैं कि उपभोक्ता आन्दोलन की जड़े भारतीय संस्कृति एवं सभ्यता की समृद्ध विरासत में पायी गयी थी। प्राचीन काल में अनेक राजा–महाराजाओं ने मिलावट करने वाले और उपभोक्ताओं का शोषण करने वाले उत्पादकों के खिलाफ सक्त दण्ड का प्रावधान निश्चित किया गया था।

कुछ प्राचीन भारतीय ग्रंथ जैसे– मनु तथा कौटिल्य का अर्थशास्त्र आदि ऐसे प्रमाण हैं, जो यह स्पष्ट करते हैं कि भारत में प्राचीन काल से ही उपभोक्ता आन्दोलन संरक्ष्ण से संबंधित कानून या दण्ड दिये जाते थे।

प्राचीन भारतीय समाज में सभी वर्गो के लोग, चाहे वह निम्न जाति के हो या फिर उच्च जाति के, सभी धर्मशास्त्रों का पालन करते थे। जिनमें सामाजिक नियमों, मानदण्डों और मानव संबंधों को नियंत्रित करने वाले सिद्धॉत थे – **ये सिद्धॉत वेदो से प्राप्त हुये थे।**[9] इतिहास में ऐसा उल्लेख हैं कि प्राचीन समय में वेदो से प्राप्त सिद्धॉतों को ईश्वर के वचन के समान माना जाता था और कहा जाता था कि **वेदो से कानूनों की दिव्य उत्पत्ति हुयी हैं, जिनका समाज में प्रचार प्रसार करने का दायित्व प्राचीन समय में ऋषि मुनियों को जाता हैं।**[10] इस प्रकार वेद भारत में कानून के प्राथमिक स्त्रोत थे।

भारत में अनेक प्राचीन लेखकों तथा सामाजिक–आर्थिक, दार्शनिकों ने अपने लेखन के माध्यम से इस बात की पुष्टि की हैं कि आज जो उपभोक्ता आन्दोलन संबंधी सिद्धॉत व कानून हैं, वह सब प्राचीन धर्म शास्त्रों, वेदों तथा ग्रन्थों की देन हैं। इसमें सबसे अधिकारिक ग्रन्थ – **मनु स्मृति (800 ईसा पूर्व से 600 ईसा पूर्व), नारद स्मृति (100 ईसा पूर्व से 200 ईसा), याज्ञवल्क्य स्मृति (300 ईसा पूर्व से 100 ईसा पूर्व), कात्यायन स्मृति (300 ईसा पूर्व से 600 ईसा पूर्व), बृहस्पति स्मृति (200 ईसा पूर्व से 400 ईसापूर्व तक), इसमे सबसे प्रभावशाली व प्रभावित करने वाली मनु स्मृति रही थी।**[11]

1. **मनुस्मृति :–** प्राचीन भारत में राजा मनु द्वारा एक मनुस्मृति नामक ग्रन्थ की रचना की गयी थी। जिसमें उस समय की सामाजिक–आर्थिक, राजनैतिक, सॉस्कृतिक गतिविधियों से लेकर वर्ण व्यवस्था तक का वर्णन शामिल हैं, **लेकिन उन्होंने (मनु) अनुचित व्यापार प्रथाओं के स्थान पर नैतिक व्यापार प्रथाओं के बारे में भी बहुत ही खूबसूरत ढंग से वर्णन किया था।**[12] उन्होंने यह भी लिखा था कि यदि कोई व्यापारी मिलावट करता हैं, तो उसे एक आचार संहिता, जो कि व्यापारियों के लिये बनायी गयी थी, के तहत दण्ड दिया जायेगा। मनु का कहना था कि – **"एक वस्तु को दूसरी वस्तु के साथ मिलाकर नहीं बेचा जाना चाहिये और न ही खराब वस्तु को अच्छी वस्तु के साथ मिलाना चाहिये तथा न ही कम देना चाहिये।"**[13] यदि कोई व्यापारी मिलावट करता हैं या **अनुचित तरीके से अपना व्यापार संचालित करता हैं, तो उसे कठोर सजा दी जायेगी।**[14]
   राजा मनु ने अपने शासन काल के दौरान न केवल उपभोग वस्तुओं की मिलावट के बारे में जोर दिया था, बल्कि कृषि क्षेत्र में भी उन्होंने ऐसा करने वाले व्यापारियों के खिलाफ दण्ड का प्रावधान रखा था। कृषि क्षेत्र में उनका प्रावधान केवल मकई की फसल और उसे बेचने के संबंध में था। उन्होंने कहा कि – **यदि कोई व्यापारी मकई उगाने वाले किसानों के खिलाफ धोखाधड़ी या मकई के अच्छे बीजों के स्थान पर घटिया बीज देता हैं और जब यह किसान मकई की फसल को बेचने जाता हैं तथा व्यापारी धोखा करते हैं, तो यह शासन को मंजूर नहीं होगा, उसे विशेष दण्ड के तहत दंडित किया जायेगा।**[15]
   इस प्रकार राजा मनु के शासन कल में अनुचित व्यापार प्रथाओं को संचालित करने वालो के खिलाफ कठोर दण्ड की व्यवस्था सुनिश्चित थी।
2. **कौटिल्य अर्थशास्त्र :–** प्राचीन भारतीय समाज में एक महानज्ञानी, राजनैतिज्ञ, कूटनीतिज्ञ व्यक्ति का जन्म हुआ था। जिनका नाम चाणक्य था, जो बाद में कौटिल्य हो गया था।

उन्होंने राजा चन्द्रगुप्त मौर्य के शासन काल में एक पुस्तक लिखी थी, जिसका नाम अर्थशास्त्र था, हालॉकि यह ग्रंथ (अर्थशास्त्र) एक राजा की शासन कालीन पद्धति, कामकाज करने का तरीका, विशेष रूप से आर्थिक क्षेत्र, एक राजा के कार्य, सैनी कैसी होनी चाहिये आदि का वर्णन हैं, परन्तु इसके अलावा उनके ग्रंथ में **प्राचीन भारतीय समाज के सिद्धॉत, राज्य एवं प्रजा को नियंत्रित व व्यवस्थित रूप से जीने का अधिकार और गलत काम अर्थात अनुचित व्यापार प्रथा को रोकने का वर्णन भी शामिल हैं।**[16] उनकी प्राथमिक चिंता प्रजा के प्रति थी। वह हमेशा प्रजा के व्यावहारिक मामले के बारे में सोचते रहते थे, इसीलिये उनके इस ग्रंथ को संरक्षण अर्थव्यवस्था में प्रमुख स्थान दिया गया था।

चाणक्य 400 ईसा पूव से 300 ईसा पूर्व के बीच एक व्यापार निर्देशक रहे थे। जिनका मुख्य कार्य राज्य में स्थित बाजार कार्य से संबंधित स्थितियों पर नियंत्रण एवं निगरानी रखना था **– वह व्यापार को विनियमित करने में राज्य की भूमिका तथा राज्य में उपभोक्ताओं (प्रजाओं) के खिलाफ होने वाले अपराधों को रोकने के लिये दण्ड के प्रावधान का निर्धारण करने में अहम भूमिका निभायी थी।**[17] उन्होंने एक व्यापार निर्देशक के रूप में प्रजा से यह आहवान किया था कि प्रजा को उच्च मूल्य वाली वस्तुओं तथा कम मूल्य वाली वस्तुओं की कीमतों के बीच अन्तर और लोकप्रिय व अलोकप्रिय वस्तुओं के बीच विभेद करना आना चाहिये। फिर वह चाहे **पानी हो या फिर जमीन, भूमि मार्ग हो या जल मार्ग, खरीद का सिद्धॉत हो या बिक्री का, उपयुक्त सभी में विभेद या अन्तर को समझना चाहिये।**[18] उन्होंने न केवल प्रजाओं (उपभोक्ताओं) के लिये सिद्धॉत निर्मित किये बल्कि व्यापारियों को भी सलाह या परामर्श प्रदान किया था। चाणक्य ने कहा कि – **"व्यापारियों को बड़े या अधिक लाभ से बचना चाहिये क्योंकि यह बुराई की ओर ले जाता हैं। इसके अलावा यदि व्यापारी समय पर मॉग के अनुरूप वस्तुओं को बाजार में नहीं बेचता तो वह आलसी हैं। इस आलस्य को दूर करना चाहिये।"**[19]

चाणक्य या कौटिल्य ने इस अवधि में वस्तुओं की उचित व सही मापतौल हेतु कुछ मानक निर्धारित किये थे। कौटिल्य ने कहा हैं कि – **"वस्तुओ को उचित मापतौल हेतु मानकीकरण के अधीक्षक को बाट (वजन) या माप के निर्माण के लिये कारखानों की स्थापना करनी होगी,"**[20] ताकि उचित मापतौल के साथ यह निर्धारण किया जा सके कि दुकानदार, उत्पादक या व्यापारी प्रजा (उपभोक्ता) को उचित वजन के साथ वस्तुये प्रदान कर रहा हैं। चाणक्य ने यह भी कहा कि – **"मानकीकरण अधीक्षक को प्रत्येक 4 माह में एक बार वजन तथा माप की मोहर लगानी चाहिये। यदि कोई व्यापारी बिना मोहर लगे अपने उत्पादों का विक्रय करता हैं, तो अधीक्षक की जिम्मेदारी होगी और वह अर्थात अधीक्षक व व्यापारी दण्ड का भागी होगा।"**[21]

इस प्रकार कहा जा सकता हैं कि चाणक्य ने अपने ग्रन्थ (अर्थशास्त्र) में व्यापारियों द्वारा की जा रही मिलावट तथा अनुचित व्यापार प्रथाओं के खिलाफ सख्त से सख्त दण्ड की व्यवस्था निश्चित की थी।

मध्यकालीन युग :– प्राचीन ऐतिहासिक स्त्रोतो से यह पता चलता हैं कि मध्यकाल वह युग या काल था, जिसके अर्थात अनेक मुस्लिम शासकों ने भारत पर राज्य किया था। इस युग में जिस मुस्लिम वंश ने सर्वाधिक राज्य किया था, तो वह मुगल वंश था, हालॉकि एक अन्य मुस्लिम शासक, जिसका नाम अलाउद्दीन खिलजी था, ने भी बाजार पर सख्य नियंत्रण स्थापित करने के लिये अपना भरपूर योगदान दिया था। मध्य युग में स्थानीय स्तर पर खाद्यान्नों की आपूर्ति करने के लिये अनाज वाहक (सुल्तान) उनकी कीमते निर्धारित करता था और उसी

कीमतों के आधार पर बाजार में विक्रय किया जाता था। इस युग में **खाद्यान्नों की कीमतों में परिवर्तन के लिये एक तंत्र था, जो अपने आप मूल्यों को परिवर्तित करता रहता था। ऐसी स्थिति में यदि कोई व्यापारी अधिक कीमत पर या वजन व माप में गड़बड़ी करता तो उसे दंडित किया जाता था।**[22] सल्तनत काल में भी जिन वस्तुओं की कीमतें निर्धारित की जाती थी, वह स्थानीय परिस्थितियों के अनुसार थी अर्थात हम कह सकते हैं कि मुस्लिम शासकों के समय उपभोक्ता संरक्षण हेतु बाजार तथा व्यापारियों पर नियंत्रण एवं निगरानी करने की पर्याप्त व्यवस्था संचालित थी।

सन 1600 ईस्वी में जब अॅंग्रेजो (डच, पुर्तगाली, ब्रिटिश) ने भारत पर राज्य करने के लिये प्रवेश किया तो उन्होंने पूर्व में संचालित बाजार नियंत्रण प्रणाली को बदल दिया था, हालॉकि उन्होंने **एक एकीकृत कानूनी प्रणाली का गठन किया था।**[23] लेकिन फिर भी अॅंग्रेजों ने अपने तरीके से बाजार नियंत्रण या उपभोक्ता आन्दोलन संबंधी कानून गठित किये थे।

ब्रिटिश शासन ने उपभोक्ता संरक्षण हेतु जिन कानूनों या अधिनियमों की स्थापना की थी, वह इस प्रकार हैं – **''सन 1860 का भारीय दण्ड संहिता, 1872 का अधिनियम, 1918 का उदार ऋण अधिनियम, 1930 का माल की बिक्री संबंधी अधिनियम, 1940 का नशीले उत्पाद तथा कॉस्मेटिक्स वस्तु संबंधी अधिनियम।**[24] ये सभी कानून उपभोक्ताओं को वैधानिक संरक्षण का अधिकार प्रदान करते हैं।

15 अगस्त, 1947 में जब भारत ब्रिटिश शासन से स्वतंत्र हुआ तो भारत सरकार ने सर्वप्रथम घरेलू उद्योगों को संरक्षण प्रदान करने तथा विदेशी प्रतिस्पर्धा से घरेलू बाजार को बचाने के लिये नीतियॉ निर्मित की गयी थी। हमारे देश में जो उपभोक्ता आन्दोलन आरंभ हुआ था, वह सामाजिक शक्ति तथा अनुचित व्यापार प्रथाओं के खिलाफ उपभोक्ताओं की रक्षा व अधिकारों के साथ शुरूआत हुयी थी। यहॉ भारत और पश्चिमी देशों में उपभोक्ता आन्दोलन में कुछ अन्तर दृष्टिगोचर होता हैं। पश्चिमी देशों में इस आन्दोलन का कारण औद्योगिकरण था, जबकि भारत में भुखमरी, जमाखोरी, कालाबाजारी, खाद्यय पदार्थो में मिलावट आदि की वजह से उपभोक्ता आन्दोलन ने जन्म लिया था। कुछ ऐतिहासिक स्त्रोतो से यह ज्ञात होता हैं कि **सन 1962 में चीन तथा 1965 में पाकिस्तान के साथ युद्ध के कारण खाद्यान्नों की कमी उत्पन्न हो गयी थी। जिससे सन 1970 में मुद्रा–स्फीति ने जन्म लिया, यहॉ महा–मुद्रास्फीति का मतलब व्यापक स्तर पर मुद्रास्फीति का सृजन होना था।**[25] जिसके परिणामस्वरूप कई बड़े संगठन तथा व्यापक स्तर पर लेखको ने अपने लेख के माध्यम से उपभोक्ता आन्दोलन की चिंगारी सृजित कर दी थी और सरकार पर दबाव बनाना आरंभ कर दिया था।

भारत सरकार ने इन सब समस्याओं को ध्यान में रखते हुये उपभोक्ताओं के हितो व अधिकारो के संरक्षण हेतु जो कानून या अधिनियम पारित किये, वे इस प्रकार हैं – **खाद्यय अपमिश्रण निवारण अधिनिमय 1954, आवश्यक वस्तु अधिनियम 1955, मानक वजन एवं माप अधिनियम 1976 – इन अधिनियमों की एक महत्वपूर्ण विशेषता यह हैं कि उपभोक्ता को साबित करने की आवश्यकता नहीं हैं, केवल पुरूषों या सामान्य आदमी की आवाज पर भी लागू हो जाता हैं अर्थात ये कहा गया था कि अपराध सख्त दायित्व होते हैं, किसी विशेष इरादे या ज्ञान पर निर्भर नहीं होते हैं।**[26]

भारत में सन 1980 से 1990 तक की अवधि में उपभोक्ता आन्दोलन ने गति पकड़ी अर्थात यह अवधि इस आन्दोलन की विस्तार व समेकन की स्थिति को दर्शाता हैं, परिणामस्वरूप एक सख्त व प्रचलित अधिनियम सन 1986 अस्तित्व में आया था। इस अधिनियम को उपभोक्ता संरक्षण के क्षेत्र में क्रॉति के नाम से जाना जाता हैं, क्योंकि यह एक ऐसा कानून या अधिनियम था, जिसमें उपभोक्ता के लिये पर्याप्त सुविधा के साथ–साथ सरल व आसान था अर्थात **कम कागजी कार्यवाही, कम काम में देरी और कम व्यय के साथ अस्तित्व में आया था,**[27] इसलिये इसे आम आदमी का कानून या गरीब लोगों का कानून आदि की संज्ञा दी गयी थी। यह मिलावट करने वाले तथा अनुचित व्यापार प्रथाओं को अपनाने वाले व्यापारियों के खिलाफ एक प्रगतिशील व व्यापक कानून हैं। **यह देश में 24 दिसम्बर, 1986 को गठित किया गया था।**[28] यही ऐसा कारण हैं कि आज पूरे भारत में 24 दिसम्बर को राष्ट्री उपभोक्ता दिवस के रूप में मनाया जाता हैं।

भारत में इस कानून को उत्पादकों तथा निर्माताओं के कदाचार से बचाने वाला सबसे अधिक उदार सामाजिक विधायिका के रूप में जाना जाता हैं। इसे बढ़ता हुआ परिवर्तन तथा उपभोक्ताओं की बढ़ती हुयी जरूरतों को ध्यान में रखते हुये कई बार संशोधन किया गया था। जिससे कानूनों को समयानुसार मजबूती प्रदान की जा सके अर्थात हम कह सकते हैं कि देश में कैसा भी कानून या अधिनियम पारित कर दिया जाये, अनुचित व्यापार प्रथाओं और मिलावट को रोकना नामुमकिन हैं, क्योंकि आज की भागदौड़ या तीव्र गति से चलने वाले दुनिया में हर व्यक्ति व्यस्त हैं, हर एक व्यक्ति अपनी आर्थिक स्थिति को मजबूत करने के लिये रूपया या पैसे के पीछे भाग रहा हैं। उसके पास इतना समय नहीं हैं कि वह मिलावट करने वालो के खिलाफ कोई कदम उठाये या शिकायत करें, जैसे–जैसे वैश्वीकरण की प्रक्रिया अग्रसर होती जा रही हैं, वैसे–वैसे रोजगार के अवसरों में वृद्धि के साथ आय में भी आशातीत वृद्धि हुयी हैं – कहने का मतलब यह हैं कि जब तक उपभोक्ता ऐसे व्यापारियों के खिलाफ सख्त से सख्त कदम नहीं उठायेगा या जागरूक नहीं होगा, तब तक मिलावट या अनुचित व्यापार प्रथाओं को रोकना असंभव हैं। भले ही सरकार कैसा भी कानून या अधिनियम निर्मित कर दे, सफलता, तभी प्राप्त होगी, जब उपभोक्ता जागरूक होकर ऐसे निर्माताओं या उत्पादकों के खिलाफ शिकायत नहीं करेगा।

13.4 निष्कर्ष :–

उपभोक्ताओं के अधिकारों व हितों को सुरक्षा प्रदान करने के लिये विभिन्न देशों की सरकारों ने जितने भी कानून या अधिनियम पारित किये हैं, उसके लिये वह सरकारे प्रशंसा के पात्र हैं, परन्तु क्या इन कानूनों या अधिनियमों से उपभोक्ता के साथ धोखा नहीं होगाा? क्या ये कानून उपभोक्ता के हितों को सुरक्षा प्रदान में सक्षम साबित होगें? क्या उपभोक्ता इन कानूनों का उपयोग कर रहा हैं, जबाव हैं नहीं, क्योंकि आज की भागती दौड़ती जिंदगी में किसी भी उपभोक्ता के पास इतना समय नहीं हैं कि वह इन कानूनों का इस्तेमाल करें और अपने साथ होने वाले धोखाधड़ी के खिलाफ खड़ा हो सके, आज का युग आर्थिक युग हैं, जिसमें प्रत्येक व्यक्ति रूपया या पैसे के पीछे भाग रहा हैं तथा आर्थिक समृद्धि हेतु संभावनाये भी हैं। जब से सम्पूर्ण विश्व की अर्थव्यवस्थाऐं एकीकृत होकर वैश्वीकरण में परिवर्तित हो गयी हैं, तब से रोजगार के अवसरो के साथ–साथ आय में भी वृद्धि हुयी हैं। इन सब कारणों ने आज के उपभोक्ताओं को इतना अधिक व्यस्त कर दिया हैं कि वह यह नहीं देख रहा कि मैने जो भी वस्तु बाजार से क्रय की हैं, वह उचित हैं, मिलावट युक्त तो नहीं, कीमत को लेकर मेरे साथ

धोखा तो नहीं हुआ आदि, इसीलिये वर्तमान में पूर्व की तुलना में कही अधिक मिलावट युक्त वस्तुऐं आ रही हैं और कोई भी व्यक्ति या उपभोक्ता आवाज नहीं उठा रहा हैं।

अतः मेरा मानना हैं कि जब तक उपभोक्ता जागरूक नहीं होगा, तब तक कैसा भी कानून क्यों न हो, अनुचित व्यापार प्रथाओं और मिलावट जैसे कुकृत्य समाप्त नहीं होगे, यदि हमें इन सब कुकृत्यों से निजात पानी हैं, तो उपभोक्ता और सरकार दोनों को मिलकर एक साथ काम करना होगा, तभी उपभोक्ताओं के अधिकार व हित सुरक्षित रह सकेंगे।

13.5 संदर्भ ग्रंथ सूची :–

1. Beers, C (1953) A mind that found itself, Garden city, New York, Doubleday.
2. Growth of Consumer movement in India. (www.prweb.com), 22 June 2002.
3. What is consumer movement? Meaning, Definition and Features. (www.articles-junction.blogpost.com), 27 June 2013.
4. Ibid
5. The History of Consumer Movement. (https://advocatetanmoy.com) 28 August, 2018.
6. G.C. Aggarwal (1989) Consumer Protection in India, National Seminar on Marketing Challenges in the Nineties. Department of Commerce, Delhi School of Economics University of Delhi.
7. Thanalingham and Kochadai (1989) An Evolution of Consumer Awareness – Indian Journal of Marketing.
8. N. Kumar and N. Batra (1990) Consumer Rights Awareness and Action in Small cities Indian Journal of Marketing.
9. Shraddhakar Supakar, Law of Procedure and Justice in India, 38 (1986). Veda means Knowledge. There are four vedas:- the Rigaveda the yajurveda, he somaveda and the Atharvaveda.
10. Ibit at 39.
11. The Periods mentioned against each smriti are taken from Gurjeet, Supra note 1 at 705-6.
12. It is interesting to note that manu was the first to write about the eighteen heads or titles of litigation and matters pertaining to buyers and consumers, including money lending, deposits and pledges, sale without ownership of property, non-performance of contracts and breach of contract of sale etc.
13. Manu, The Law of manu, 290 (Georg Buhler trans., 1990)
14. Ibid at 393.
15. Ibid at 394.
16. See R.P Kangle, The Kautiliya Athasatra – Part II (2^{nd} ed. 1972) (hereinafter Kangle Part II)
17. Supra Note 3.
18. Kangle Part II, Supra note 19, at 127.
19. Ibid
20. Ibit at 134.

21. Ibid at 137.
22. To see the reference number (17).
23. MARC, Galanter, Law and Society in Modern India 15 (1997).
24. To see the reference number (17).
25. Dr. Sheetal Kapoor (2017) – Empowering the Consumer. (www.employmentnews.gov.in) Vol. 39, 23-29 December 2017.
26. D.N. Saraf, Law of Consumer Protection in India 169 (1990)
27. To see the reference number (25)
28. To see the reference number (25).

About the Book:

In the present world, human activities are deteriorating the environment to a great extent. Air, water and all other valuable resources are depleting day by day which is now become a threat for the entire world. Time has come to aware people about those issues related to our environment and also to let them know about the various pros and cons. To sustain the global health, we need to work together; we need to live in harmony with mother nature so that we can leave the earth as it is for our future generations.

Therefore, the objective of this book was to enumerate the various present day problems faced by our environment and also how to mitigated with those issues on the basis of the knowledge and research done by the learned academicians across the globe. We sincerely believe that this book will be of great value and a research guide for all of us especially to the environmentalists. I hereby offer my sincere thanks to all the learned academicians, researchers across the country who contributed to this book and enriched it with their valuable inputs.

About the Editor:

Dr. Sangeeta Das *is an Assistant Professor of Botany at Bahona College, Jorhat, Assam, India. She did her Ph.D from Dibrugarh University, Assam, India. She also worked as DST Women Scientist (WOS-A) at Assam Agricultural University, Jorhat, Assam, India. She has edited many books and published a number of research papers and popular science articles in reputed journals and magazines. She has presented number of research papers in different National and International Seminars/ Webinars in and around the country. She has also delivered talks on various issues as resource person both inside and outside the country. She is a member of editorial board (Honourary) in International Journal of Integrated Research and Development (IJIRD), Journal of Intellectuals (JOI) and a reviewer in many National and International Journals.*

KRIPA DRISHTI PUBLICATIONS

Kripa-Drishti Publications
A-503 Poorva Heights, Pashan-Sus Road, Near Sai Chowk,
Pune – 411021, Maharashtra, India.
Mob: +91 8007068686
Email: editor@kdpublications.in
Web: https://www.kdpublications.in

ISBN: 978-93-9

9 789390 847020